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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Foundry Trades Equipment and Supplies Association.

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13 to 15, Wilson Street, London, E.C.2.

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Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 2, Royal Metal Exchange, Swansea.

Forthcoming Events.

APRIL 17.
Institute of Metals (Sheffield Local Section):—Ordinary meeting. "Extrusion," Paper by R. Genders, M.B.E.
Institute of British Foundrymen.
APRIL 11.
Newcastle-upon-Tyne Branch (Junior Section):—Annual general meeting, and general discussion.
APRIL 17.
Sheffield and District Branch:—Annual general meeting. "The Use of Oil in Cupola Practice," Paper by J. R. Hyde.

Wanted—A New Industry.

It has been freely rumoured in recent weeks in political club circles that a tax would be imposed on foreign iron and steel entering this country as a revenue-producing measure, but now it seems abundantly clear that this is not to be the case. It does seem desirable, however, that the electorate should be in a position to judge the effect of such a movement from a business standpoint, because politicians only put forward slogan-like statements which hide the real truth. Such a postulation as "to import iron and steel at from £11 to £20 a ton is good business," will not hold water, because the two figures do not refer to the same kind of iron and steel. One could, with an equal amount of truth, call one "chalk" and the other "cheese," as there is no common denominator of industrial significance. One of the largest and most important factors on the import side of iron and steel is basic Bessemer, whilst exports are made up of pipe, both cast and wrought, high-priced special steels and so on. Thus, as an argument for the continuation of existing affairs, it fails miserably.

For the proposition to be attacked logically, all that is needed is a dual survey of raw materials and plant available for making the material now imported, together with an appreciation of alternatives. Unquestionably, we are as well placed as our foreign competitors in the matter of raw materials, which reduces the question to two factors only:—(1) Have we suitable plant for making the material forming the bulk of the iron and steel imports? (2) Could we supply economically alternative suitable material?

It is a matter for regret that the answer to both these questions is in the negative, if we assume that the most important item is basic Bessemer in the form of semi-finished material; no such material is being made, and the plants available are obsolete. The question of substituting basic open-hearth is ruled out on technical grounds, as it does not possess the essential property of lending itself to deep working. Moreover, it is inherently more expensive. Basic-Bessemer steel has inherited a poor reputation for quality, but this ignores the great technical post-war developments. The raw material—liquid pig-iron—is now kept within reasonable compositional bounds, whilst the control of the manufacture has passed from the old-type "blower" to the trained metallurgist.

Thus an essential prerequisite for reaping a true and lasting benefit from any imposition of a tax on imported steel is the immediate recreation of a domestic basic-Bessemer industry, constructed according to the best modern practice, together with some convincing data that modern basic-Bessemer steel is not "muck."

The Pulverised-Fuel Furnace.

The visit of Dr. Bardenheuer to Newcastle-upon-Tyne to lecture on the pulverised-fuel furnace draws attention to the very rapid progress being made by this melting unit. Dr. Bardenheuer is a leading member of the staff of the great Iron Research Institute at Düsseldorf, and has given special attention to cast iron. Such a visit is in harmony with the general international interchange of ideas that has been an outstanding feature of the foundry world in the past few years. There is a constant effort to secure a lower total carbon in foundry irons, shown by the use of refined irons and by these melting developments.

The progress of these new methods will be followed very closely by the industry. At the moment two furnaces are in actual successful operation, but several more are almost ready for putting into commission, mainly for use in the malleable industry. As there is an under-consumption of malleable iron in this country, compared with other lands, the products of these new plants should find a ready market, even though extremely high outputs are possible when the furnaces are "pushed."

These developments should, moreover, be good for the cupola, and it is equally evident that the cupola is not taking them lying down, so to speak. There have been several developments of an important character, and we look to the time when the cupola will not only melt cheaply—its outstanding advantage, at present, coupled with a measure of elasticity in working and ability to produce large or small quantities as required, but also yield a uniform and homogeneous metal. A much greater measure of respect must be given to it if this is to be accomplished; weighed charges, low-ash coke, carefully-distributed material across the stack with a proper proportion of flux, combined with recording instruments for the control of the air supply. Under such conditions we think it may be made to retain much of its hold as the universal foundry melting furnace, leaving the new types to carve out their own particular niche to cater for the ever-increasing demand for special irons and to manufacture high-quality and malleable irons, with probable incursions into non-ferrous metallurgy. The future of the hot-blast cupola is problematical, but there should in the next five years be an enormous amount of business in the replacing of existing melting plant by that designed to give greater economy, better temperature, greater uniformity and better quality of metal. It seems reasonably sure that the melting costs are virtually the same as in the cupola, except, of course, in the aspect of amortisation of the whole plant. The cupola, together with the staging, charging apparatus, blower or fan and electric motor, probably cost less than the rotary furnace, pulverising plant, steel work, pipe work, regenerators and various motors. Type and quality of material are now the factors governing the choice of furnace for melting for foundry purposes.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Ore Size and Speed of Malleablising.

To the Editor of The Foundry Trade Journal.

Sir,—As a metallurgist who has always specialised in grey iron, I have often wondered why white-heart malleable ironfounders do not crush the iron ore they use for annealing into a fine powder, as, so far as I understand this process, it is a question of chemical reaction between solid Fe_2O_3 and carbon. Thus the more intimate the contact between the casting and the ore the quicker would be the process. I expect there is some question of interfusion. However, I should be interested to learn the effect of the grain size of ore on the speed of process.—Yours, etc.,

J. A. Jones.

Cardiff,
April 1, 1931.

Malleable Cast Iron.

To the Editor of The Foundry Trade Journal.

Sir,—I note in your issue of February 12, page 128, that during the discussion on the Paper by Mr. H. H. Shepherd, Mr. C. H. Kain mentioned that the Harvester Company, at Roubaix, was producing black malleable cast iron from the cupola and that from the chemist's information they were getting low carbon and very good results.

I must point out that the process of producing black-heart malleable in the cupola from an all-steel and ferro-alloy charge is my patented process. In England it dates from April, 1927, whilst a German patent has also been accepted.

My process utilises low carbon, high silicon and high manganese, and yields a maximum stress ranging between 22 to 25 tons and an elongation of from 10 to 15 per cent.

It must be said that the chemist of the Harvester Company was working with me in 1927 and gathered enough information enabling him to institute part of my process at the end of 1927, when he took service with this company.—Yours, etc.,

Christian Kluijtmans, B.Sc.,
Specialist in Malleable.

56, Rue de la Commune, Bruxelles,
March 29, 1931.

Notes from I.B.F. Branches.

London Branch.—The annual general meeting of the London Branch of the Institute of British Foundrymen will be held on April 16 at 8 o'clock at Edibell Sound Film Apparatus, Limited, 89/91, Wardour Street, London, W.1. After the meeting the Carborundum Company, Limited, Manchester, will kindly show their film, "The Jewels of Industry," dealing with the manufacture and industrial application of carborundum.

Catalogue Received.

Electric Ovens.—A four-page leaflet (L.T. 31) received from Messrs. Birmingham Electric Furnaces, Limited, of Birlec Works, Tyburn Road, Erdington, Birmingham, describes a range of resistance electric furnaces designed for drying, baking and low-temperature heat-treatment processes up to 350 deg. C. These are applicable to a number of processes connected with the foundry industry, such as mould and core drying, enamelling castings, casting strain removing and so on. Of the four standard models listed, the internal dimensions vary from 1 ft. 6 in. by 1 ft. 3 in. by 1 ft. 6 in. to 3 ft. by 5 ft. by 5 ft.

French Foundrymen's Association Elects New Officers.

At a general meeting of the Association Technique de Fonderie, held on March 19, the following officers were elected:—

President.

Mr. Jules Cury, foundry owner, of Deville (Ardennes).

Vice-Presidents.

Mr. E. Dady, President of the Association Amicale et Mutuelle de Fonderie.

Mr. A. Damour, iron master, of Bayard (Haute Marne), immediate Past-President of the Association.

Mr. J. Derdinger, non-ferrous foundry owner at Paris, President of the Non-ferrous Foundry Owners' Federation.

Mr. H. Magdelénat, managing director of the Société des Usines de Rosières at Bourges (Char).

Mr. L. Montupet, managing director of the Société des Fonderies, Montupet, at Paris.

Mr. E. Ronceray, directeur of the Paris Foundry High School, chairman of the Etablissements Bonvillain et Ronceray, at Choisy le Roi (Seine).

Mr. H. Sandre, managing director of the Société Métallurgique du Périgord at Paris.

Foreign Vice-Presidents.

Belgium.—Mr. J. Léonard, President of the Association Technique de Fonderie de Belgique.

Spain.—Mr. J. M. Espana, deputy chairman, Etablissements Bonvillain et Ronceray, and honorary commercial attaché to the Spanish Embassy at Paris.

Italy.—Mr. C. Vanzetti, C.B.E., managing director of the Fonderia Milanesi di Acciaio at Milan.

Luxemburg.—Mr. L. Brasseur.

General Secretary.

Mr. C. Koehler, general secretary of the French Foundry Employers' Federation, and managing director of the Fonderies de St. Ouen (Seine).

Treasurer.

Mr. A. Lardin, manager of Messrs. Lardin & Company, and a Past-President of the Foundry Mutual Benefit Society.

Cardiff Technical College Visited by Welsh Founders.

The annual meeting of the Wales and Monmouth Branch of the Institute of British Foundrymen, held on March 28, was preceded by a visit to the Cardiff Technical College. The party was met by the Assistant to the Principal, Mr. Loveridge, who explained the work of the engineering department of the College, after which a tour of inspection was made and tea served.

The annual meeting followed at the University College, Cardiff, when the following officers were elected for the ensuing year:—

President, Mr. R. J. Richardson. *Senior Vice-President*, Mr. W. Williams. *Junior Vice-President*, Mr. F. J. Taylor, J.P., O.B.E. *Hon. Secretary and Treasurer*, Mr. J. J. McClelland. The Branch Council consists of the following representatives:—Messrs. S. Domville, A. Hares, T. D. Richards, C. E. Richards, D. Rogers, W. R. D. Jones, F. L. Coles, Ivor Rees and S. Southcott.

The Handy Man.—A workman had seen the electrician test fuses with a lamp bank. One night he wanted to test some fuses. He procured a single lamp socket and a 110-volt lamp, and applied it to a 500-volt circuit. The result was a short circuit that shut down the entire plant.

Random Shots.

Certain gentlemen are now to be seen on the Brighton beach industriously making modern alligators, apes and lions from Brighton's renowned sands. They are practising their art once more in preparation for the far-distant summer season, when holiday-makers will expect to see the sands of our seaside resorts graced with noble examples of the moulder's craft, and will (if it cannot possibly be eluded) pay for the privilege of admiring these. Moulders who feel attracted by a lucrative "busman's holiday" should investigate the idea, although, perhaps, the only golden thing in it is the opportunity.

* * *

I imagine that members of the American Foundrymen's Association have need to submit their persons to a prolonged course of physical training prior to the Association's annual convention, which will again be held, next month, at the Hotel Stevens, in America's most notorious metropolis—Chicago. At least thirty-four Papers will be presented, and in the long list of authors' names, those of Mr. F. A. Melmoth, Mr. George Batty, Mr. Vincent C. Faulkner and Mr. F. J. Cook are equally well known on both side of the Atlantic Ocean (yes, I do really mean the "herring pond"). Despite hard times and—as the Editor has snappily termed it—frozen cheque-books, there seems to be no marked decrease in the number of exhibitors at the exhibition, which is staged in conjunction with and under the same roof as the convention.

* * *

This is how a schoolboy described the heart and its functions or work:—"The heart is a comical-shaped bag. The heart is divided into several parts by a fleshy petition. These parts are called right artillery, left artillery and so forth. The functions of the heart is between the lungs. The work of the heart is to repair the different organs in about half a minute. A pain in the right artillery is called heartburn. A pain in the left artillery is called love."

* * *

Another youngster, seeking to demonstrate by example the meaning of "cynical," and confusing it with "conical," declared that a cynical lump of sugar was one pointed at the top. Cynical men more than once have been defined as doctors.

* * *

Imaginary Intimate Interviews.

I.—*The Self-Made Man.*

Listen here! That story I tell the news guys ain't the truth—it's publicity. Besides, it encourages my office boys. I never ran barefoot along Broadway selling news-sheets. I wasn't an orphan, I had a real homy home an' my father wasn't a drunkard. My first step towards big business wasn't trundling a pea-nut barrow along movie-palace queues. How did I make my first thousand dollars? I was coming home from a little party one night, picked up a magazine in the park and saw that the crossword puzzle was completed. I sent it in and won the prize. That enabled me to start business as a married man, and well—come and meet the wife. She's brought in the dollars ever since, an' I've kept the stenographers in order.

Marksman.

Patternmaking and its Relationship to Design and Foundry Practice.*

By Matthew Russell.

The production of any casting falls naturally into the performance of the following operations, taken in the order of their sequence: (1) Designing, (2) patternmaking, (3) moulding, (4) casting and (5) fettling.

The title of the Paper commences with patternmaking, because this branch of the production of castings does not function as it should, outside of mass-production work, and ought to have a closer relationship with design and foundry methods. The majority of foundrymen will say "Agreed." But what have they done to improve this condition of affairs? If called upon to give their suggestions during design or pattern construction, are they not rather, possibly, elusive, or probably trade-shy, perhaps due to inability to understand the drawing. This state of affairs should be altered where possible, and the opportunity of advising the younger members of the Institute of the advantages of being able to visualise from a drawing what is required, and thereby airing their views during the design stage, cannot be passed over. No one desires to take the blame of wrong methods, and everything should be done to improve the position of the foundry in the face of the keen competition which now exists.

Designing Castings to Compete with Weldings.

Commencing with design, it is difficult to understand how any designer or draughtsman can successfully carry out his work without a fair knowledge of patternmaking and moulding methods. This desirable state of affairs, unfortunately, does not always exist, and for confirmation of this, one often only requires to examine castings produced to drawing-office specification and requirements, which not only give bad castings, but may be costing about 50 per cent. more than they should. This state of affairs is giving engineers grave concern, and, owing to the high costs of patternmaking and moulding, they are searching for cheaper substitutes, and hence the reason for the adoption of weldings in certain cases. One noticeable feature of this relatively new departure is that engineers are being compelled to simplify their designs in order to make this method of construction possible.

Now, if one compares the design of an article produced by this new method against the original design called for as a casting, it is often found a considerable saving in favour of the fabricated material simply on this question of simplified design alone. This, surely, is not a fair comparison, as one may find, by adopting the fabricated-material design, that the position could be reversed in favour of the casting, provided that the moulder and coremaker keep their product to the desired thickness, and do not, as is sometimes found, add anything up to 25 per cent. to the weights by ingenious manipulation. Owing to the fact that he is being paid by weight, this increasing of weight may appeal to the founder as being good business, but it is a very short-sighted policy, and, in fact, very like craft-suicide, in the face of competition with weldings.

The author has had occasion to make many comparisons of results under the best-designed conditions, and where the pattern-shop and foundry methods were subjected to proper planning before proceeding; and in the majority of these cases the castings were found to be cheaper, and a better job, than weldings. It is obvious in many cases that the success of this new method is being more or less brought about by the present costly procedure of obtaining castings, and unless the foundry industry becomes more closely associated with the pattern shop and drawing office, with a view to eliminating the expensive costs caused by wrong designs and unnecessary patternmaking, it will end with the further advancement of welding methods. An outstanding example of the same sort of thing is the case of motor-car bodies, which were originally made of wood, which the users desired, but in which the costs became prohibitive, and to-day wood bodies are the exception.

No doubt many, whilst agreeing, will ask: "What is the remedy?" to which the answer

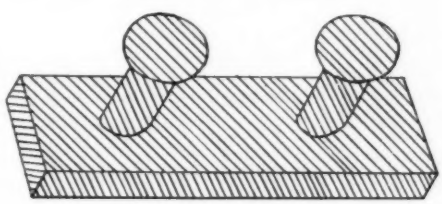


Fig. 1.

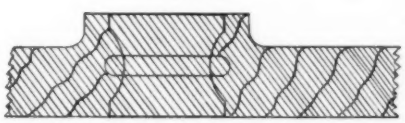


Fig. 2.

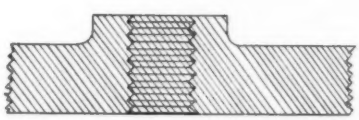


Fig. 3.

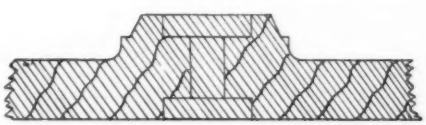


Fig. 4.

Figs. 1 to 4.—Developments in the Use of Chaplets.

is: "Specialise in design and methods of production!" Some time ago, whilst visiting several foundries in Belgium, the author was much surprised to find one firm having a special department employing several moulders, all of whom were employed in producing castings from full-sized drawings on boards, in green sand and dry sand, not loam. The owner of this foundry had realised the necessity that the customer should not be saddled with the high cost of patterns, and he was also capable of collaborating with the designer regarding the elimination of moulding difficulties, to such an extent as to be able, in some cases, to accomplish his requirements with the aid of gauges and setsticks, in place of patterns.

The Three Principal Elements.

Castings are made for engineers and to their design, and it is to them that founders must look in the first place to put the foundry, to the advantage of all concerned, on a more equal competitive basis with weldings. The three principal elements of castings are: (1) Designing, (2) patternmaking and (3) moulding, and it is often the case that the high cost of castings and patterns has arisen because these departments are not properly linked up; and, in consequence, they are not being properly managed as one complete unit, each department adopting methods to suit its own particular viewpoint; for example:—

Designing.—The designer has sometimes a weakness for artistic lines, rather than practical requirements, due to his unfamiliarity with the manufacturing methods employed for the production of castings, and his failure to realise how much these add to the cost of production.

Patternmaking.—On account of lack of knowledge of the possibilities of foundry methods, the patternmaker is often inclined to make unnecessarily expensive patterns and core boxes. He might, even, at times make his patterns of such a design that a totally wrong or unnecessarily expensive method of moulding has to be adopted.

Moulding.—The failure to recognise the necessity for standardised labour-saving devices. If founders would get together and pool their experience, it would be of great benefit to the industry. The result of the combination of the above is high costs.

One satisfactory method of instituting order is the following:—Whilst under process of scheming in the drawing office, a preliminary drawing should be issued to the pattern shop, foundry and rate-fixing department for their recommendations. This procedure, if carried out properly, can be made to save the pattern shop, foundry and machine shop hours of labour; also the extra risk of bad castings could be avoided by having provision made for the venting and holding of cores. Unfortunately, the advantages of a procedure of this nature are not always realised by the average foreman as they should be, and this is often caused by his lack of experience in reading drawings.

It has become apparent that a great deal could be accomplished by the standardisation of methods, such as the indication on patterns of such forms of runners and risers as have been found most satisfactory. This procedure would eliminate the question of the method of casting arising each time a pattern came into the foundry, and would obviate the state of affairs which are found at present, namely, the size of the runners and risers, and their position, varying even during the process of making several off to one order by the same operator. This is sometimes the cause of bad castings, though this unfavourable result is frequently attributed to the casting temperature or the mixture of the metal, or some other plausible excuse is put forward. It is much better practice to have a casting which is naturally fed, by having the correct size of runners and risers, than one which is fed by a feeding rod.

Conserving Technical Data.

A practical proof of this came under personal notice in a foundry making silicon-bronze castings. The castings in question had a very heavy boss, embodying the riser and runner usually considered suitable for this job, and were hand-fed. Unfortunately, it was found, with a quick-freezing metal of this nature, that the castings were seldom perfect. The founders carried out a considerable amount of research work, and eventually discovered a satisfactory method. Some time later this job repeated itself, but on this occasion was in the hands of an operator who had not been conversant with the previous trouble, with the result that the whole procedure of failure and experiment had to be re-enacted. This time, however, the founders profited by their experience, and formed the runner and riser permanently on the pattern. It is obvious, therefore, that there is much room for improvement in the foundry in this direction, as too much is left to the judgment of the individual moulder, who in most cases adopts the method most convenient to himself.

* A Paper read before the Scottish Branch of the Institute of British Foundrymen, Mr. N. McManus, M.B.E., presiding.

The Use of Chaplets.

To overcome this state of affairs, it is suggested that a responsible person should see that the pattern is properly marked where the riser and runner have to be applied, and a pattern of the runner and riser handed out with the job. Take also the question of holding down cores. How many good castings are spoiled on account of a faulty design of chaplet being adopted? Being responsible for a large number of hydraulic-pressure castings, the author was compelled to take control of the foundry as regards the number of chaplets they should use and also in regard to the design. The average moulder would have two or three times the number of chaplets necessary, and always in the most inaccessible positions for plugging, if necessity arose. A good method is to have a

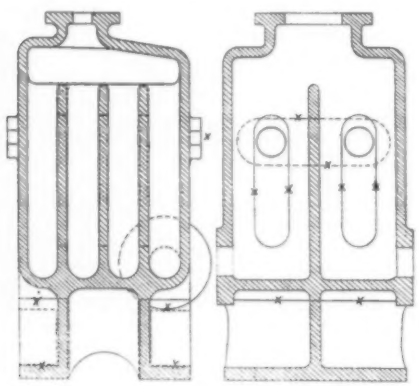


Fig. 5.—A Typical Case showing the need for Re-designing to Facilitate Production.

washer on the pattern where chaplets are required, which compels the moulder to discard this absurd design for hydraulic work, shown in Fig. 1, and adopt the method shown in Fig. 2, which, by using cast iron, is found to be the best for heavy work, but the malleable chaplet (Fig. 3) used in this manner is also found quite satisfactory. Should there be any signs of sweating under pressure, cut away a small diameter of the washer which contains the chaplet head, as indicated in Fig. 4, and one can easily caulk; whereas the other design in cast iron more easily rusts up.

Engineers generally ask, "Why use chaplets at all?" and undoubtedly, in a great many

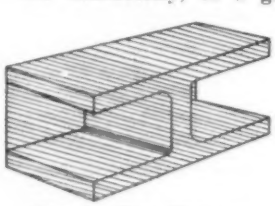


Fig. 6.—This Foot was Cast Separately.

cases, the patternmaker and designer could assist the moulder in this respect by making provision for internal- or external-core bearings, but how many draughtsmen, or patternmakers for that part, ever give this a thought? In all fairness to moulders, they deserve credit for securing cores as they do, and their difficulties should not be added to unnecessarily.

A Case for Re-Designing.

A typical example of this occurred in personal experience quite recently, a couple of fairly large vessels being required for an urgent repair. The drawings were not submitted in the usual manner for approval, and Fig. 5 shows what was received from the drawing office.

After a chat with the designer as to the risk of making a casting of this design, both in venting and slackening, it was found that we could be allowed to have a hole through the cross-webs on each side of the large dividing web. By adding four plug-holes, which were used for the venting and breaking of core irons when slackening, this made a rather difficult job comparatively simple. It also enabled cores to be made complete in two halves.

The modifications which were allowed are marked with crosses, the feet (see Fig. 6) also being cast separately, saving an unnecessarily large box and cheapening the cost.

A Badly-Designed Pump Casing.

Another example of a wrong decision being made, due to the designer having insufficient knowledge of foundry methods, was a large pump casing, which was required to be coupled up to existing piping, the drawing office being instructed to commence from pipe B. Fig. 7 shows its initial appearance whilst after submitting for criticism, Fig. 8 indicates what was adopted. It has had the extension pipe cast

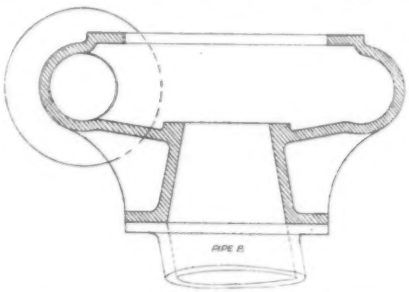


Fig. 7.—A Badly-Designed Pump Casing.

separate, thereby considerably cheapening patternmaking and moulding costs.

Take now the question of making parts symmetrically at the line of parting of the pattern. How often does one find complete patterns and core boxes being made when, with a little foresight on the part of the designer and patternmaker, only one-half would be necessary? A typical example of this was a large branch-piece which was recently encountered in what is considered to be one of the most up-to-date engineering firms, which has its own foundry and plant suitable for plate-moulding, with jig-pinned boxes. It was rather a surprise to find that complete pattern and core boxes were supplied, although these castings were only required at odd times.

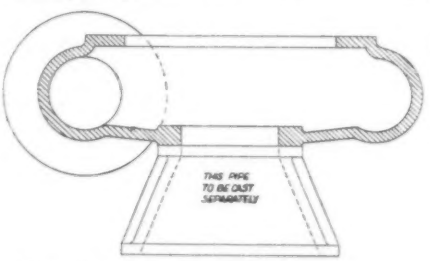


Fig. 8 shows Fig. 7 Re-designed to Help Moulding.

Personal experience has indicated that it is possible to have plate-moulding introduced into general jobbing foundries, for work of this nature, with only a slight modification to their existing plant. For odd work of this nature, a normal method would have been to supply a half-pattern (Fig. 9) with branches A and B portable and used alternatively on the general service plate for drag and top.

A Novel Pattern Plate.

A skeleton half core box would be made on the same lines, with branches cut out of each side and filled in; alternatively, another method would be to clay-thickness the mould and make cores from this, thus dispensing altogether with the use of core boxes. Moulders may be interested in the following method, which is adopted in the author's general jobbing foundry work to enable half-patterns to be used with general foundry plant. There is a flat board or plate made for general service work of this nature, and the only addition required to existing boxes is to have a setting block pinned to each end or side of boxes. The sight-hole blocks are the complete depth of the top part, and only 2 in. or 3 in. deep in the drag. The pattern is then laid down on the pattern plate, which has jig-pinned pins, and sight-holes A, B, C, D, Fig. 10, located in suitable holes provided on the plate. The box is then placed on top of the plate, with setting blocks on the same centre line as the locating parts on the plate, and the locating portions are brought into the correct position, which is permanent for the drag and top part, and secured with slot-bolts on the underside of the plate. After completing the ramming of the drag, the pattern is secured with screws and turned over. The same procedure takes place with the top parts, except with the addition of hangers.

A Moulding Problem Solved.

This method has been found so satisfactory that two half-patterns, with ordinary moulding,

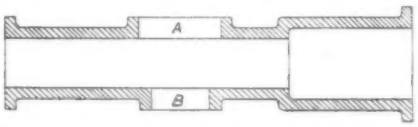


Fig. 9.—A Pipe Branch as an Example of Plate Moulding.

can have their drags and tops, and even middle parts, assembled direct from the plate. Provided that several plates were adopted in the foundry, this arrangement would be very suitable for splitting up a job, and would save unnecessary levelling of beds. Mr. J. Longden has posed the question of moulding a cylinder with gills, for a one-off job, without a pattern.* Taking this problem as a typical example to demonstrate the use of the service board, and the method suggested at that time, by which the cylinder could be made from a half-stucco shell pattern. A pattern of this description costs approximately £3 10s., but the reduction in moulding time would amply pay this expenditure. It is false economy to try to avoid spending money on really necessary patternmaking, and then have to spend more than the amount saved on the moulding.

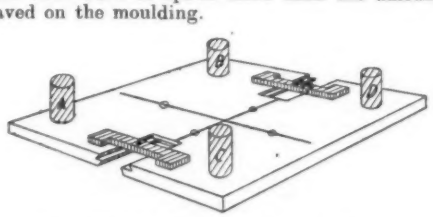


Fig. 10.—A Novel Pattern Plate.

The stucco model, which is half-size except in length, is mounted on the general service board, as previously described. The drag half-box is put on top, and the pattern secured with wood screws, for which provision has been made on the prints. The drag is then rammed up and turned over. The core block is now taken away, and two half-cores made from the drag half-mould. The pattern is then withdrawn, and again mounted on the service plate for completing the ramming of the top part. This completes the moulding, the holes through the gills being formed by core box, as shown in Fig. 11.

* See Foundry Trade Journal, February 19, 1931, page 138.

A Green-Sand Moulding Job.

Another example of the possibilities of the foundry is the making of swept-up circular castings, such as is shown in Fig. 12, in green sand, in the following manner: A ring is provided and let into the foundry floor, also a pin centre, as indicated. After sweeping out the top part, the centre boss and webs are put into place, and the box forming the top part laid on, the necessary hangers being applied, and stakes driven home outside the box. The top part is then removed, and part webs, etc., withdrawn and finished. Finally, the board is applied for sweeping out

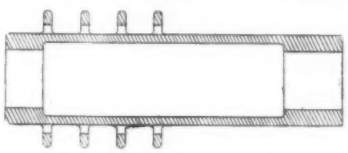


Fig. 11.—A Cylinder having Gills presents novel Moulding Features.

the thickness on the drag half, thus completing the moulding. The advantage of this method is that moulding and casting can be completed in the same day.

In connection with the general procedure of the location and assembly of boxes, this is an operation which is done very crudely, and has been the cause of scrapping castings on account of joints being very eccentric. Fig. 13 shows a locating cone. By having several cups A placed on a level bed with the pattern, the latter is rammed up, and when turned over, the top part cone pin is placed in cups A and tops put on, thus ensuring a reliable joint, without

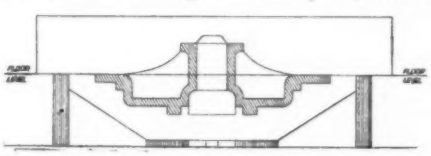


Fig. 12.—Method of Moulding Swept-up Circular Castings.

adhering to the absurd and antiquated method of "sun about" when closing.

Competition from Weldings.

There are many patternmaking saving devices which could be adopted without much, if any, increase in moulding costs, and unless those who are engaged in the manufacture of castings find more ingenious methods and have them universally recognised and adopted, probably it will be found, as already mentioned, that weldings will often be substituted. One firm which had a turnover of some 300 tons of castings per month have reduced this by 100 tons. This is not due to lack of orders, but to the introduc-

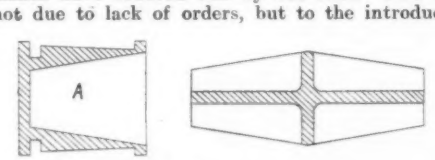


Fig. 13.—Locating Cones.

tion of weldings, and this has been largely brought about by the inexperience of the designers in regard to the possibilities of pattern-shop and foundry practice, and also by want of initiative on the part of foundry managers and foremen, in not taking a hand in design, as the makers of weldings are doing at the moment.

Engineers would find great saving by having a larger proportion of responsible men in their design departments, with a knowledge of patternmaking and moulding. These men would have sufficient experience to enable them to cut down costs by making designs which would be practical and not unnecessarily elaborate. By so doing they would probably find the saving in cost far beyond their expectations. It will be agreed that in many cases the want of linking up these operations, as is nearly always done in machine-shop management, has proved more costly than is generally realised.

DISCUSSION.

Mr. M. McManus, M.B.E. (the chairman), said that they were much indebted to Mr. Russell for having given them a thoroughly practical Paper. It contained points upon which he thought discussion would take place, as well as ideas which would probably be new to some. He knew that Mr. Russell was an exceedingly busy man, and, whilst listening to the Paper, he wondered how he had been able to find time to prepare it.

Mr. J. Longden said Mr. Russell had given them much to think about. The illustrations which had been shown of fabricated castings, or, perhaps, he should say structures, were particularly instructive, and he could quite see that competition from that source was likely to be severe. He agreed with Mr. Russell in thinking that if the foundryman and the designer could get together and agree to the same modifications as were accorded the welder, the balance in favour of the welder would be reduced. In regard to the question of chaplets in castings for pressure work, Mr. Russell was probably correct in advising the use of cast-iron chaplets with a washer on the pattern at the points where they are required. It was a fairly simple operation to plug or caulk. He was convinced that the designer did not consider the foundryman sufficiently. The air vessel which had been shown was an excellent example. There was too great a partiality for curves and radii; the designer did not realise what a big increase in cost was caused by putting a large radius at the joint. He thought that in many cases the æsthetic was carried too far. Mr. Russell had shown them a pattern of what he discussed with them a few weeks ago, a cylinder with gills, which was a one-off job. There was a good deal in Mr. Russell's method, provided that the service plate and tackle were available. He would like to know how Mr. Russell would attach the gills to the pattern so that they would be able to stand up to the burning and erosion of the metal. He supposed that the core would be rammed up in the half-mould.

Mr. Russell, agreeing, said that it would be rammed in half-mould and the two halves joined.

Mr. Longden, continuing, said that, assuming that one had all the tackle available, the plan suggested by Mr. Russell was a very good one, but in the absence of it, one had to adapt what tackle one had by him.

The Inroad Made by Weldings.

Mr. J. M. Primrose said that he had been very much interested in the Paper; it was one of the best he had heard in that room. He did not consider that there was need to worry very much about weldings now as they did two years ago. Fabrication had come into its own for certain jobs, and had been ruled out for others. He was at a London Branch meeting two years ago, in company of a manager who employed between 400 and 500 men, and who was worried about his foundry, as he had spent £7,000 in plant. He found to-day that three-quarters of the work had returned to the foundry and the remaining quarter would never come back. Although that engineering firm had its own foundry, it was a good thing the quarter going to the welder, as it left the foundry free to do more work. Some time back Mr. Sam Mavor told them of a group of five or six firms who had an arrangement whereby they visited each other's works, having a lecture the night before on the work in hand and the methods in use. He thought that, if Mr. Russell's principals allowed him to come to the meeting and read a Paper, they would allow them to exchange visits to the foundry, provided other principals reciprocated, and, of course, the works were all equally up to date. He considered that such an interchange of visits would be of great value to all of them. He knew that Mr. Mavor's remarks, which appeared in the Journal, had been taken to heart in the Birmingham district, but he was afraid that the Scots' canniness had stood in the way of such a thing there. It was all to the good to be able to hear the other man's opinion and a description of the manner in which he worked, but it was much more useful to see the processes in operation. If the foremen were able to visit each other and exchange views, much more good would result. As far as fabricated articles were concerned, the foundryman could not compete when it was a case of one off. He had had some experience in his own works of one-off jobs, and the price of the casting was prohibitive, but when it came to making the second one, they had the welder beaten, as they re-used the same pattern.

Mr. McCulloch said that Mr. Russell had spoken about runners and risers, correctly placed and sized, giving natural feeding, leading to better castings than when the rod is used. He also had advocated the standardisation of runners and risers. It all depended on the material which had to be used for casting; if Mr. Russell had to use a variety of metals or alloys, he would soon find the trouble he was up against. The cutting off of the risers was also a difficulty with some materials. He would like Mr. Russell to give a little more information about the locating pins, especially the one he had in the cope. Did he think that the sand would hold it in position so that it would not drop out or would it require wires to hold it?

Castings Gaining Ground.

Mr. J. M. Primrose said that, with regard to welded articles, instead of castings, he would like to tell them that two years ago he visited the Industries Fair with two foundrymen who were astounded at the amount of fabricated work on view. This year he went round with the same two foundrymen, and they were very surprised at the amount of weldings missing from the same stalls.

Mr. T. Bell said that he had been interested in Mr. Russell's Paper, although it had taken a different line from what he expected. Regarding weldings, he had certainly received some consolation from what Mr. Primrose had told them. Like Mr. McCulloch, he had been very interested in the guides for closing the boxes, and would like to know how they were kept from falling out.

Mr. Brownlee said Mr. Russell had dealt with the subject in a manner that was a little unusual. In the case of the pattern of the pump casing, which was stated to have been altered so as to allow the pipe to be cast separate, what did Mr. Russell do with the webs? Were they run through the pipe?

Mr. Russell: There was no necessity for any web running from the pipe.

Mr. Brownlee: You eliminated the webs completely?

Mr. Russell: Yes, they were found unnecessary.

Mr. Evan Ross said he had been very interested in the idea of the locating cores and thought that generally the means of registering boxes very good, but he would like to know more about the method.

Mr. Rankin said that with the exception of what had been said about weldings the Paper appeared to be more in favour of the foundry than against it. He thought that Mr. Russell's arrangement for centring the boxes would give a lot of trouble. He thought that the main cause of trouble in centring and making good joints was to be found in the pattern shop. There should be some suitable

provision made for closing. There were very few patternmakers who made provision for drawing a pattern. As regards co-operation and consultation between designer, draughtsman and foundryman, there were too few opportunities for the foundry to get into consultation with the designer. As a rule, the foundry only saw the pattern when it was delivered to the moulder, and a price had to be given without seeing the designer.

Mr. McGhie said that the locating cores described by the author had interested him, and he thought would be useful in a jobbing shop, but when it came to the question of making a hundred boxes a day, he thought it would not be of much use.

AUTHOR'S REPLY.

Mr. M. Russell, in replying to the discussion, said that Mr. Longden had asked about the method of attaching the gills to the pattern. The core ran right through the body of the pattern, and there was a print on the top side and also at the joint. He sprigged between the gills. Mr. Russell here demonstrated the manner of working with the model of the pattern exhibited.

In reply to Mr. Primrose, who had suggested that his principals should give an invitation to visit their foundry, unfortunately, or perhaps fortunately, his firm had no foundry.

Mr. McCulloch had spoken about the risers and the trouble in cutting them off. He had also mentioned that the turner and machineman on piecework grumbled about the extra cutting. He thought that Mr. McCulloch had no reason to complain about that, as he went in for large risers more than anybody he knew. Mr. McCulloch would be interested in a casting (exhibited), which was made in silicon-bronze and the riser was cut off with a hand saw. With regard to the question of holding the locating core, he had expected that point to be raised, as when he himself first saw it he wondered how it was held. There was no question of any gadget for holding it, and when he first saw it in actual use, confessed to having the same fear as Mr. McCulloch. If any moulder was afraid that it would drop out he could use an eye bolt. (Mr. Russell sketched on the board certain details showing the holding of the core.)

Mr. Rankin had stated that the pattern was the main cause of bad joints; well, knowing Mr. Rankin personally, he would not dispute the statement. He thought that there was something to be said for making some arrangement for the closing of the mould.

Mr. McGhie had raised the question of the use of locating cores in mass-production foundries. There was no question of using them in that way, they were for jobbing work.

Mr. N. McManus, in closing, said that he thought that they had spent a very profitable afternoon in listening to and discussing a very practical Paper. They often heard the complaint that they did not get enough practical Papers, but he thought no one would complain of Mr. Russell's Paper in that direction. He thought that they had had more discussion than on any Paper given during the session. He had given them many points and many views to look at the patternmaker. He himself had seen similar locating pins used in Germany, where they were simply jar-rammed the mould and dropped in the pins and then jar-rammed the cope again. Using a jarring machine, the pins were placed anywhere in the mould and just kept the joint.

He asked them to accord a vote of thanks to Mr. Russell in the usual manner, to which Mr. Russell suitably replied.

Belting Requires Attention.—A slipping belt is the cause of much unnecessary power loss, which is directly proportional to the slip. If the slip amounts to 2 per cent., the power loss is 2 per cent. If the slip is 5 per cent., the power loss is 5 per cent. Excessive slip may also cause burning of the belt.

Still Cheaper Copper?

By "Onlooker."

Copper continues to provide thrills in plenty, for so nicely balanced is the situation that both bulls and bears can give ample reasons why their own particular views should prove to be correct. At the beginning of the year the price in America was 10½ cents, but at the time of writing 9¼ cents is about the level in New York, although the exporters are quoting to Europe on the basis of 10 cents. During the first quarter of the year London and New York have battled for supremacy, and at the moment London is undoubtedly taking the lead and forcing the pace towards a reduction in values. A certain amount of second-hand metal is available below 10 cents in the States, but it is fairly evident that at least some of the big producers are averse from cutting 10 cents, and it may be that they are responsible for the report that now Easter is over one is to witness quite a burst of buying.

Somewhat sensational suggestions have been made lately regarding the likely course of copper prices in the near future, and 8 cents has been mentioned as not only possible but likely. This would mean a sterling equivalent of less than £40 per ton, and standard copper in London would be changing hands at but little over £35. The reason for this further sharp fall in the quotation of the red metal is given as enormous present stocks and the likelihood of huge additions at no far distant date. Existing reserves of copper are undoubtedly very large, but they are not so onerous as they were, and the blister tonnage has come down from quarter-of-a-million short tons to about two hundred thousand, while a start has been made on reducing the stocks of refined. Quite recently, too, it was announced that representatives of the Katanga interests were crossing the Atlantic to confer with the American producers on the advisability of still further reductions in output. Great efforts have undoubtedly been made by the big copper people to get production down, and it seems very unlikely that the price is going to be allowed to fade away after the output has been brought down to 100,000 short tons per month.

As to the future potential supplies of copper, it is, of course, well known that both Africa and Canada have immense reserves which are now being developed at a fairly rapid pace, but the trade depression and the unremunerative level to which copper has fallen have put a check on progress of this sort which will endure until it is reasonably certain that price stability at something better than 10 cents can be achieved. In the long run it is difficult to see how copper can be other than a cheap metal, for there is unquestionably an enormous amount available for world consumption, and with modern methods of mining and refining, production costs are nothing like as high as they were in pre-war days. Deposits, however large, cannot last for ever, and for this very reason a mine must be regarded as a wasting asset and selling prices adjusted accordingly to guard against the inevitable climax when the ore finally is exhausted. It must also be remembered that copper is virtually indestructible and that as the mines exhaust their supplies a secondary reserve is being built up in the manufacturing system and in various plants and equipments scattered about the world. Such copper remains off the market for varying periods, but sooner or later it is almost certain to become available for melting down again, and recollection of the depression on values exercised by the unloading of big tonnages of secondary material in the immediate post-war period is fresh in everybody's mind.

That consumption of copper is closely bound up with the progress of civilisation cannot be doubted, and until the impoverished European nations get on their legs again the more extended use of the red metal must tarry. On the whole, bear factors appear to outweigh bullish tendencies at present, but it must be remembered that the existing price is quite exceptionally low and has already discounted most if not all of the bad points in the situation. There is a tendency to-day to regard the ruling price as copper's normal level, and upon that assumption to weigh up the pros and cons of possible rises and falls. This is quite unsound, and although some recession may be seen from 10 cents, a higher level rather than a lower seems likely during the second half of 1931.

The Sir Archibald MacInnes Shaw Prize for Foundry Students.

To mark the coming of age of the Scottish Branch of the Institute of British Foundrymen, the Branch Council offered to place at the disposal of the Corporation of the City of Glasgow a capital sum, the interest on which should be devoted to the provision of a prize for students attending foundry classes in the evening continuation schools of the Corporation. The Corporation has accepted the offer, and agreed to the Council's suggestion that the prize be known as "The Sir Archibald MacInnes Shaw Prize."

Sir Archibald MacInnes Shaw, who is head of Messrs. Shaw & MacInnes, Limited, Firhill Iron Works, Glasgow, and chairman of the Greensand Pipefounders' Association, was invited to become President of the Scottish Branch at its inception. It was probable that, but for the fact he was about to assume office as Lord Provost of the City, he would have accepted. He has, however, rendered valuable service to the Branch and the industry during the past 21 years. As Lord Provost, Sir Archibald presided at the first civic reception accorded to the Institute by the Glasgow Corporation in 1911, and has been present on each subsequent occasion when, during the annual conferences, the members have been the guests of the City. Sir Archibald took the part of host, received and welcomed the members of the overseas delegation to the International Convention when they visited Scotland during the pre-convention tour in 1929.

Contracts Open.

Barking, May 13.—Piping equipment, for the County of London Electric Supply Company, Limited, County House, 46-47, New Broad Street, London, E.C.2. (Fee £5 5s., returnable.)

Copenhagen, April 20.—Six centrifugal feed-water pumps, etc., for the Copenhagen Lighting Department. The Department of Overseas Trade. (Reference G.X. 10,261.)

Dublin, April 21.—Three overhead travelling cranes, for the Dublin Port and Docks Board. The Engineer's Office, Dublin Port and Docks Board, East Wall, Dublin, C.10. (Fee £1 1s., returnable.)

Callander, Scotland, April 11.—485 tons of cast-iron pipes and special castings, for the Town Council. Mr. J. M'Michael, town clerk, Callander.

Hull, April 20.—Cast-iron water main, etc., for the Corporation. Mr. J. N. Waite, city electrical engineer, Sculcoates Lane, Hull. (Fee £1, returnable.)

Llanrwst, April 16.—12,350 yards of cast-iron spigot and socket water pipes, etc., for the Urban District Council. Mr. C. F. Farrington, engineer, Trinity Square, Llandudno. (Fee £5 5s., returnable.)

St. Mellons, April 17.—520 yards of cast-iron water pipes, etc., for the Rural District Council. Messrs. Thomas & Morgan & Partners, civil engineers, 23, Gelliwastad Road, Pontypridd. (Fee £2 2s., returnable.)

Rust can be removed from steel by rubbing with the following mixture:—Potassium cyanide, ½ oz.; castile soap, ½ oz.; and whiting, 1 oz. This should be mixed and sufficient water added to form a paste.

The Brackelsberg Furnace at Bingley.

We recently took advantage of an invitation issued to us by Mr. A. Howgate, of Messrs. Clegg & Howgate, Limited, of Bingley, Yorkshire, to inspect their Brackelsberg furnace installation. This progressive firm, which only occupied its present premises some four years ago, is to be congratulated on the enterprise it showed in being the first British foundry to instal and work the first rotary pulverised-fuel-fired furnace. The furnace, which has a nominal capacity of 3 tons, but a working one of 4 tons 10 cwts., is used exclusively for the manufacture of high-grade malleable cast iron. It consists of a 4 ft. 6 in. dia. cylindrical shell formed of steel plate, 15 ft. long, carrying a 12-in. acid refractory lining. The ends are conical, one being the aperture for a Brackelsberg burner and the other facing a refractory-lined box leading to the regenerator for preheating the air for combustion. The furnace is rotated on a roller-path through gearing by a 2-h.p. motor. For charging and tapping, the furnace is tilted by a pinion geared to a toothed quadrant.

transference of the metal to the moulds is effected in 100-lb. double hand shanks. Heat is kept on the furnace for the first 10 min. of this period to ensure hot metal.

When the tapping is complete, the furnace is tilted in the opposite direction, that is, towards the exhaust end of the furnace, which provides a method for the rapid evacuation of the slag. This slag, of which there is about 3 cwts. per cast, is of extremely low iron content, vitreous, but sometimes carries a greenish tinge, due, it is said, to the presence of manganese.

After patching, if necessary, the furnace is tilted to the position for charging, which operation can easily be effected in 15 min., the time naturally depending on the weight of the charge and number of labourers available for its handling. In order to protect the lining, the lighter material is first charged, followed by the heavier.

A good deal of nonsense has been talked about the lining of these rotary furnaces. It has been the subject of gossip that their life is short and that their replacement is a serious manufacturing cost. After our visit to Bingley, coupled with knowledge of other plants, we are convinced that the reverse is the truth. The cost of fettling and patching the average cupola is a far heavier cost than is generally admitted. It ranges between 3s. 6d. and 10s. per ton of metal melted. Some plants may run more economically, but the more we investigate this subject the more we are convinced that it is an extremely important item of cost in the average foundry.

This particular Brackelsberg furnace started its present campaign on December 18 of last year, and at the time of our visit had made 161 casts. An inspection of the lining gave us the impression that it would last until Whitsuntide with normal care. Unlike a cupola, the problem of patching is that of repairing a virtually horizontal plane as against a vertical wall; material can be placed in position whilst the furnace is white-hot, and heat is available for its fritting into position. Actually, the problem, at least so far as this furnace is concerned, is exactly the same as an acid open-hearth furnace, except that one tackles opposite places on alternate heats, otherwise one would be attempting to patch the roof!

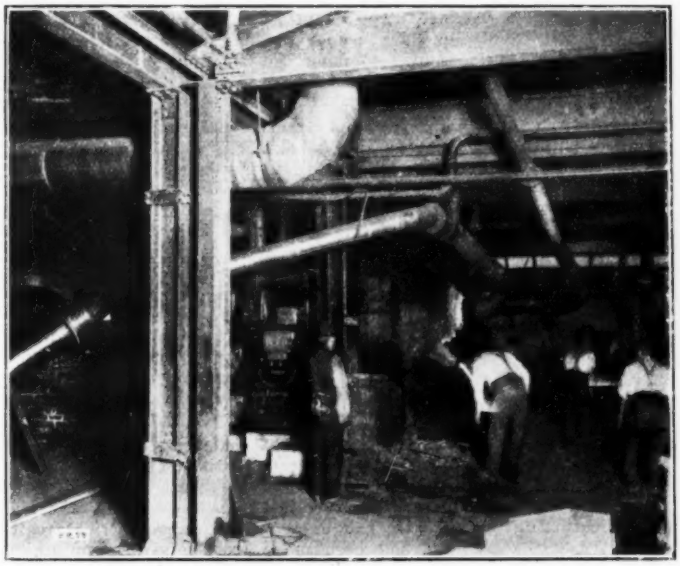


Fig. 1.—The Brackelsberg Furnace installed in the Works of Messrs. Clegg & Howgate, Limited.

Fig. 2.—The Charging Platform.
The loading end of the furnace is conveniently situated for receiving the contents from the barrow shown at the right of the weighing machine.

The fuel, a cheap coal, arrives at the charging platform by means of an inclined concrete ramp, where it is rough-screened. The large pieces are retained for use in the gas plant connected with the annealing plant. It is pulverised in a ring role pulveriser manufactured by the British Rema Manufacturing Company, Halifax, until only 5 per cent. is retained on a 185-mesh sieve. It is then taken by cyclone to the burner. The mill, which is sufficiently large to provide fuel for a second furnace, is driven by a 10-h.p. motor.

At the time of our visit, the last melt had been cast at 5 p.m. on the previous day, when it was charged up with 3 tons of metal. After half hour of firing the furnace is moved a one-third turn, and during the next hour this is repeated twice, after which rotation is continuous. A pleasing feature of the Brackelsberg furnace is that the burner is suspended and balanced by a counterweight, so that it is readily removable, giving the same access to the bath as is the case with the lifting of a door in open-hearth practice.

The charge was ready for pouring in 3½ hrs. This operation, under the conditions operating in this plant, takes about 15 min., because the

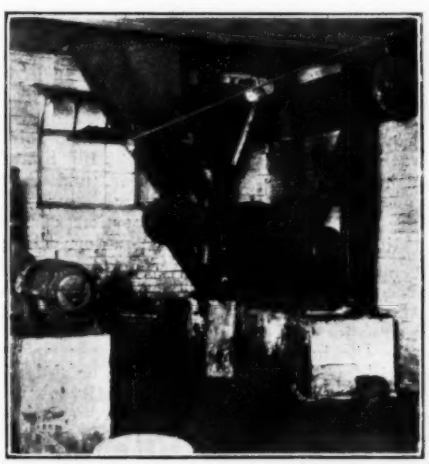


Fig. 3.—The Pulverising Plant.
This is situated beneath the charging platform, and has been supplied by the British Rema Company, of Halifax.

We, too, had heard this gossip of the short lining life of rotary furnaces and actually protected a novel method for their confection, but after inspection we are convinced that no departure from the established methods is necessary.

The Product.

We spent a good deal of the time at our disposal examining the product of this furnace. The most outstanding feature is the fact that it has been found possible to shorten an already reduced annealing period by 20 per cent. Messrs. Clegg & Howgate's material is probably lower in carbon, silicon, manganese, sulphur and phosphorus than is general in the trade. This gives a metal softer in the white state and capable of being annealed to extreme softness in a minimum of time.

The annealing furnaces are different from normal practice. They are sunk in the ground and fired through a series of ports running along the length of the furnace by producer gas. This permits of crane loading and discharge, whilst a series of refractory arches, carried in a steel frame, form the roof.

The metal, which has excellent casting proper-

(*Concluded on page 262.*)

Blast-Furnace Reactions and the Production of Pig-Iron.

Mr. J. E. Fletcher's Paper "Some New Views on Smelting and Remelting Processes"—which has been appearing in serial form in recent issues—gave rise to a discussion and a certain amount of controversy when presented before the Sheffield Branch of the Institute of British Foundrymen. An abstract of the discussion is given below.

Large High-Output Furnaces.

The Hon. J. M. W. North (Branch-President) said that, after Mr. Fletcher's remarks on blast furnaces, he began to wonder whether they were advancing or going backward. He felt that in this country they would always have small furnaces. The quality of their ores undoubtedly prevented them following the Continental practice of large furnaces giving very large outputs. However, it was a question nowadays whether they would follow the rest of the world and produce their goods as cheaply as possible. To do that they would have to have a large production and large furnaces. He would like to have Mr. Fletcher's views on that point and whether he could foresee this country producing from the large furnaces an iron which by suitable mixing would be equal to the cast iron they got from using cold-blast iron. He thought that that was really the crux of the matter.

Mr. J. E. Hurst observed that Mr. Fletcher had covered a wide variety of subjects, ranging from the comparison of various classes of pig-iron to his theory of their constitution, ultimately giving them an insight into the vast amount of work he had done on cupola design. One of the questions that seemed uppermost in Mr. Fletcher's mind related to the merits of cold-blast pig-irons. In his view the question was largely an economic one. Leaving the matter of pig-iron, he would like to say something about Mr. Fletcher's theory. He first came in contact with this in an article which Mr. Fletcher published in the technical Press. Unfortunately, there were a large number of printer's errors in the article, which made it difficult to understand. If he understood Mr. Fletcher aright, he took it that the essential feature of his theory was that what he called the fluid (?) carburised iron collected in the hearth of the blast furnaces, and all the reactions by which the additional elements Si, Mn, S and P were reactions between this fluid carburised iron and the slags in the hearth of the furnace. If he was correct in that assumption he could not say that he was in agreement with Mr. Fletcher. For example, he could not think that the MnO existed in the slag simply as MnO. It probably existed as manganese silicate, and that was very difficult to reduce. It did not seem to him to be quite plausible to assume that the whole of the manganese was absorbed by reaction between the carburised iron in the hearth of the furnace and the manganese silicate in the slag. If they followed that argument further in regard to a ferro-manganese furnace, would it be right to assume that the whole of the manganese of ferro-manganese was obtained by a slag reaction in the hearth of the furnace? He thought they must await the publication of Mr. Fletcher's Paper before they could thoroughly understand it in the detail that it merited. The most interesting part of the Paper, and the part that indicated the stupendous amount of work done by Mr. Fletcher, was the latter portion. He could not express adequately how interested he was in it. He would like to convey to Mr. Fletcher his appreciation of the enormous amount of work he had done in connection with the cupola which, as he supposed they were fully aware, had been designed by him under the auspices of the British Cast Iron Research Association. What they would all have liked to have seen was a diagram showing the composition of the gases in Mr. Fletcher's own cupola. He hoped that some day Mr. Fletcher would be persuaded to show them that. As he (the speaker) had said on a previous occasion, the design of the foundry cupola, even in the hands of recognised makers, had been in a parlous condition for many years. Now, thanks to Mr. Fletcher and the British Cast Iron Research Association, they had available at last a rational design, and he, for one, wished Mr. Fletcher and the Association every possible success with this.

Incidence of "Kish."

Mr. J. Roxburgh stated that he was interested in the question of "kish" in cast iron, as, at the foundry with which he was connected, they were called upon to make castings with a guaranteed analysis of 0.05 per cent. sulphur and phosphorus, which necessitated the use of special hematite, which contained high total carbon and large graphite flakes. He wondered whether in the case of such a "kishy" iron, melted in the cupola, it would be possible, by the method of melting, or by the temperature of casting or by an alteration in the composition, to rid the iron of the bad effects due to the "kish."

On one of his slides Mr. Fletcher showed a phenomenon on the surface of a chilled roll which he suggested had caused a breakage. He (the speaker) did not know whether he had understood Mr. Fletcher correctly, but thought that he had mentioned graphite in that connection, which latter could hardly be expected in a chilled roll. He would appreciate his further comments on this point.

With reference to the melting of semi-steel in a foundry, he thought that a great amount of superheat was required in order to be able to deal with the iron successfully for casting. In this connection he mentioned the Brackelsberg furnace, where a very high temperature was obtained and where the iron was not in contact with the fuel. He personally knew that mixtures containing 50 per cent. steel were being successfully melted in this particular furnace, which latter had an extensive application on the Continent.

Mr. G. Oxley spoke of a proprietary process that he once tried for removing kish, and said that although it brought all the dirt and slag to the top in fluid form, enabling them to skim it off as best they could, it was not satisfactory in its effect.

AUTHOR'S REPLY.

Mr. Fletcher said that he appreciated Mr. Hurst's difficulty in regard to some of the points raised. It was difficult to discuss Papers on somewhat complex problems without having read them previously. He felt that a head-to-head talk by way of thrashing out the doubtful points was the only satisfactory way. He himself thought the theory a rational one, and hoped that when the published Paper was read they would see that there was a portion of new eutectic reformed in the alloy constituent through recarburisation.

The whole theory turned on the conception that it was the carbon in the primary sponge-iron-eutectic that provided the necessary agent for the alloying reactions. With respect to the formation of the primary eutectic, he did not contend that in all cases this constituent was purely eutectic; this constituent was sometimes hypo-eutectic, containing less than 4.3 per cent. carbon, and at other times it was hyper-eutectic, containing more than 4.3 per cent. carbon. The reasons for this would be found in the published Paper.

Referring to the use of cold-blast iron in locomotive cylinders, for example, he knew that cylinders made from mixtures containing a goodly proportion of cold-blast iron gave excellent results, and in certain British and Dominion railways the life of such cylinders had been remarkable. Some of them had been in service for so long that there has, as yet, been no opportunity of testing whether modern hot-blast irons can compete with them on the score of long life. There are numerous cases, however, where locomotive cylinders made from hot-blast irons have given very short service. In this and other parallel instances the risk of using cheaper hot-blast irons appears to be too great.

Failures of American Semi-Steel.

A large factor in the cylinder-wear problem is that of structural homogeneity in the iron used. Mr. Fletcher thought that this problem was not receiving the attention it ought to have. Dr. Moldenke, who, he regretted to say, had recently passed away, had been working since the war in dealing with defects due to badly-smelted iron in the U.S.A. He (the speaker) had received many letters from Dr. Moldenke referring to disastrous cases due to the improper use of synthetic cupola mixtures containing steel scrap and poor pig-iron. Excessively high hearth temperatures and the use of promiscuous scrap in blast-furnace burdens had brought a crop of trouble to many foundrymen in the U.S.A. as well as here.

With regard to the cupola, he thanked Mr. Hurst for his remarks with reference to the gas analyses in the coke bed, and felt that he must pay a tribute to Mr. Hurst in a recommendation he made a number of years ago concerning the restriction of blast in foundry cupolas. Mr. Fletcher said that his aim in the development of the new cupola was to get rid of the free oxygen in the lower part of the coke bed, the results being highly satisfactory. Not only has the coke consumption been lower, in some cases by over 25 per cent., but the metal produced has been distinctly better in quality. He thought the way was now open to melt more rapidly and more cheaply, whilst improving the metal product.

Mr. Fletcher said that in examining many so-called semi-steel castings he had found troubles which could be directly traced to the type of mixture used in the cupola. He had recently had a case where large intricate castings had been made from mixtures containing high-phosphorus pig-iron and steel scrap, the results being disastrous. The result of cheapening the metal mixture had involved the founder in more loss than would have paid for the purchase of a year's supply of good pig-iron.

Mr. Hurst had told him repeatedly that he did not get all the results he had expected from cold-blast pig-iron. The question has often been asked whether cold-blast iron to-day was as good as formerly. In reply, he was obliged to say that some pig-iron makers could not get the ores or ironstone once readily obtainable, some of the best ore beds being worked out. He thought that properly-proportioned mixtures containing genuine cold-blast iron were producing excellent castings, comparable with those made many years ago.

With reference to the Brackelsberg type of furnace, Mr. Fletcher said he had seen it at work and had nothing but good to say of its principle so long as it was confined to the melting of comparatively small scrap. The idea that the rotating furnace mixed the metal was, perhaps, not altogether correct, as, when lining became smooth, little or no mixing of the molten metal was assured. The furnace was of the air-furnace type, and by properly adjusting the slag composition it was possible to reduce the total-carbon content. A great point in favour of the furnace was its capacity to produce hot and clean metal.

(*Concluded on page* 262.)

XUM

Some Developments in Modern Foundry Practice.*

By E. Longden.

There is in the world and the engineering industry to-day, material and the means to produce and make progress in a most remarkable manner. Developments—real developments—mean, mainly, the efficient and economical production and fashioning of materials into useful and consumable commodities. Whilst in America last year the author listened to an address broadcast by Prof. Joseph W. Roe, instructor of engineering at the New York University. His subject was "Machines that make Machines," and the address was the second in a series on "Your World and the Machine," broadcast under the auspices of the Museum of Peaceful Arts. "Slavery, or, for that matter, any kind of man-power, could never compete to-day with machine-made power." Prof. Roe said, "For every man, woman and child in America there is generated power equal to that of a hundred slaves. To build the great Pyramids, 100,000 slaves worked thirty years, dying like flies. But the Panama canal, as great a work, was built in a third of the time by a much smaller number of free men, well paid and well housed, using power and machinery under conditions as healthy as those of New York." During some subsequent discussion it was stated that in a particular industry in America they were converting ten times as much material into its particular utility as in many countries abroad, so that the American worker in that particular industry need only work one-tenth of the time as abroad to secure the same results. Efficiency to-day, therefore, lies principally in improving and perfecting the ratio of man-hours to the ton of manufactured material or article.

The enormous power of mechanisation, if sensibly controlled, to improve the general standard of well-being for all mankind, cannot be too much emphasised. The possibilities of a 90 per cent. mechanisation of industry is staggering. The author makes no apology for his unstinted praise of the industrial developments of America and his extended references to them. He has, as a Britisher, as much dislike for the boastfulness of some Americans as any of his countrymen, but he cannot, unfortunately, blind himself to the superiority of their methods of production which has been wrought, mainly by mechanisation and the perfection of organisation compelled by mechanisation as distinct from purely research discoveries. Speaking with some knowledge of the foundry trade, it must be confessed that most of the mechanical devices of an advanced nature evolved during the past twenty years are of American origin. It is quite realised that the last statement will not be very popular and may be considered unpatriotic.

Whilst there has been considerable progress during the last two decades in metallurgical discovery, the most outstanding advance, contributing to our higher standard of living, is due to improved production methods consequent on mechanisation and organisation of our manufacturing and distributive industries. This by no means belittles the part played by the improvement in the quality of materials which contributes to the economy of production.

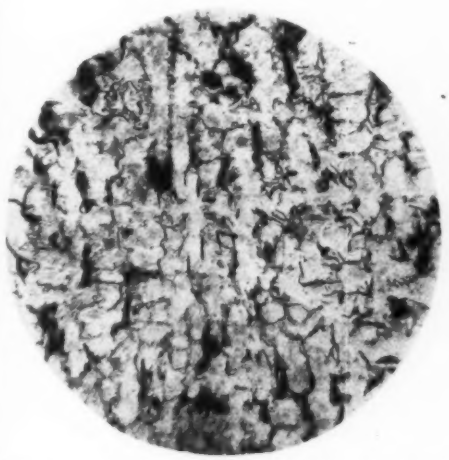


Fig. 1.—Showing Dendrites of Iron which are Outlined by Secondary Graphite. × 60 (reduced by one-third in reproduction).

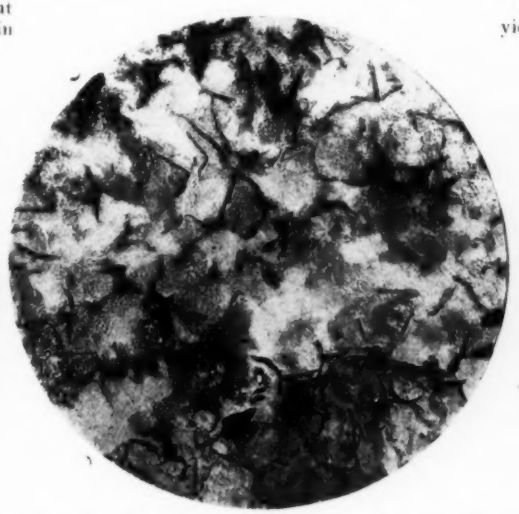


Fig. 2.—Pearlitic Cast Iron, with low total Carbon and small amounts of Sulphide and Phosphide. × 150 (reduced by one-third in reproduction).

Fig. 3.—Low-Carbon Pearlite surrounding Secondary Graphite, with Carbide-Phosphide near the Centre. × 600 (reduced by one-third in reproduction).

CAST IRON.

Cast iron constitutes probably 90 per cent. of the cast metals produced, and the author will deal with this metal, although the production methods apply to any ferrous or non-ferrous alloy. Very considerable progress has been made during the last ten years in developing special cast iron. Tensile strength up to 40 tons per sq. in. can be obtained under special conditions along with other improved properties. It is not the desire of the author to claim that such metal can be easily and cheaply obtained. Cost is the deciding factor. The most up-to-date iron manufacturers are now providing iron to approved analysis and produce excellent refined and high-duty irons of guaranteed composition.

The production of improved and high-duty iron from the alloying of steel with ordinary grey iron, and commonly known as semi-steel, has taken a firm grip on the economics of practical cast-iron metallurgy. This is especially so in U.S.A., where semi-steel is employed over an extensive and varied range of castings. The most outstanding advance made in cast-iron metallurgy is in connection with the control and production at will of a metal with the maximum pearlitic structure. Most up-to-date founders who need to make high-duty irons, such as for the important castings for gas, oil and steam engines, turbines and hydraulic cylinders, etc., know that such castings compel the use of irons which give a high-percentage pearlitic structure. Since the world war we have become very familiar with the phrase "pearlitic cast iron," due to the invention of processes which produce irons of remarkable quality. These patented processes are named Lanz, Emmel (Continental) and Meehanite (U.S.A.).

The Lanz Process.

The Lanz process consists of a temperature control of the mould into which is poured a metal mixture with low balanced constituents varying within a limited range according to section. The necessary temperature to which the mould must be heated is correlated to the section of the casting and, to a smaller extent, the constituent contents and temperature of the metal.

The average analysis of the Lanz pearlitic iron is about:—Total carbon, 3.00; silicon, 0.9; phosphorus, 0.35; manganese, 0.70, and sulphur, 0.12 per cent. Carbon and silicon may vary from 2.8 to 3.5 and 0.6 to 1.5 per cent. respectively. If poured into an ordinary cold mould, metal of this analysis in every case solidifies to give a white or mottled-white fracture.

Iron made by the author in hot moulds has yielded very convincing results. Tensile strengths of 20 tons per sq. in. can be consistently obtained, along with extraordinary impact or shock-resisting qualities not possible in any other high-strength cast iron within the author's knowledge. At the same time it is practicable to approach the 20-ton tensile in semi-steel, and in refined iron and cold-blast irons poured under the best ordinary foundry conditions, but the resistance to shock or impact possessed by hot mould iron and its freedom from gas and shrinkage cavities are of the most outstanding importance.

The microphotographs (Figs. 1, 2 and 3) were taken from hot-mould test-bars which yielded 20.5 tons per sq. in. tensile, with slight elongation. Analysis:—Total carbon, 2.85; combined carbon, 0.85; graphitic carbon, 2.00; silicon, 0.90; phosphorus, 0.23, and sulphur, 0.09.

Emmel Iron.

Emmel iron is another pearlitic metal produced by pouring specially-melted and controlled mixtures into ordinary sand moulds. Whilst samples of the iron have been tested, and melting of the metal has been noted, it is not yet clear to the unlicensed how the metal is made with certainty. However, so much can be gleaned that the process depends on a cupola charge mixture of a high percentage of steel—

* A Paper read before the Manchester Association of Engineers on March 27.

probably over 50 per cent., grey iron, ferro-silicon, ferro-manganese and doped coke, along with a cupola design and control to give a highly superheated metal of a low total-carbon content.

A typical analysis of Emmel iron is as follows:—Total carbon, 2.60; combined carbon, 0.75; silicon, 2.30; phosphorus, 0.15; manganese, 1.00, and sulphur, 0.11 per cent. Tensile strengths average about 22 tons per sq. in. and range from 17 to 27 tons, and on annealed bars considerably higher. Emmel iron properly annealed is a short cut to the production of malleable cast iron.

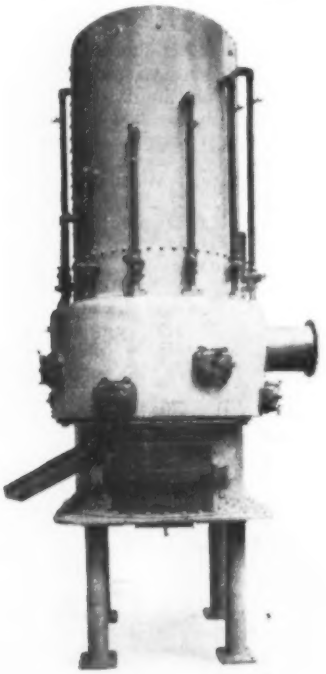


Fig. 4.—The Poumay Cupola.

Meehanite Iron.

Meehanite pearlitic cast iron is of a composition which would produce a white iron as it appears at the spout of the furnace. Graphitisation is effected by the addition of silicide of calcium to the molten iron as it leaves the melting furnace. Very little melting is done in the cupola. When the cupola is used it usually forms part of a duplexing process. The properties of "Meehanite" are excellent, as was proved to the writer in Detroit. Quite recently a well-known metallurgist exhibited at a Lancashire meeting a sample of a broken test-bar of "Meehanite" metal which had yielded the amazing strength of 40 tons tensile, but the author is of opinion that this must have been obtained from an annealed bar. In U.S.A. a large number of examples were seen which gave from 20 to 30 tons per sq. in. tensile. The analysis of commercial "Meehanite" grey iron is given as:—Total carbon, 2.4 to 2.7; silicon, 1.00 to 1.50; phosphorus, 0.10 to 0.20; manganese, 0.65 to 1.00, and sulphur, 0.05 to 1.14 per cent. These special irons cost from 10 to 20 per cent. more than ordinary high-duty irons, but economy can be secured and the extra cost can be cancelled out by a reduction in the metal section.

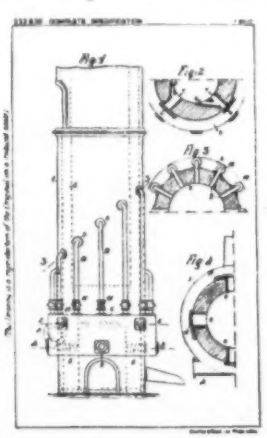


Fig. 5.—Sectional View of the Poumay Cupola.

Whilst, generally speaking, low silicon and carbon and low phosphorus irons are more resistant to growth and distortion under repeated heating than those containing higher quantities of these elements, the British Cast Iron Research Association has recently invented a metal with fairly low carbon, but with silicon contents above 5 per cent., which shows a greater resistance to growth than the irons of low silicon content. At the moment the use of the metal is confined to those castings which are not required to withstand vibration and shock; further developments are, however, expected. Increased use is being made of nickel and nickel-chromium-iron alloys for producing irons to withstand repeated heating and resistance to corrosion and for irons of non-magnetic properties. Considerable success has recently been achieved in the production of cupola pearlitic cast iron by the addition of nickel to cast iron. It will be recognised that apart from the special irons protected by patent rights the most marked progress has been made in the economical production of high-duty irons by the use of steel additions and refined irons.

MELTING FURNACES.

The properties of any metal or alloy are very considerably influenced by the methods of melting and the character of the fuel used. Steel and non-ferrous metals have long been melted in furnaces where it has been possible to determine and maintain fairly consistently the chemical and physical properties of the required metal. The types of furnaces are well known, and consist of various electric furnaces, reverberatory or open-hearth furnaces, Tropenas converters, Bessemer converters, and pit crucible melting furnaces. In U.S.A., and to a lesser extent in Britain and Europe, the air furnace has been used almost exclusively for melting and alloying for black-heart (American) malleable iron, although in U.S.A. the employment of the electric furnace for this purpose is by no means in the background. Again, both in America and Europe special alloyed cast irons, such as for chill and grain rolls, are melted in the air furnace, and in rare instances, on the Continent and America, in the electric furnace.

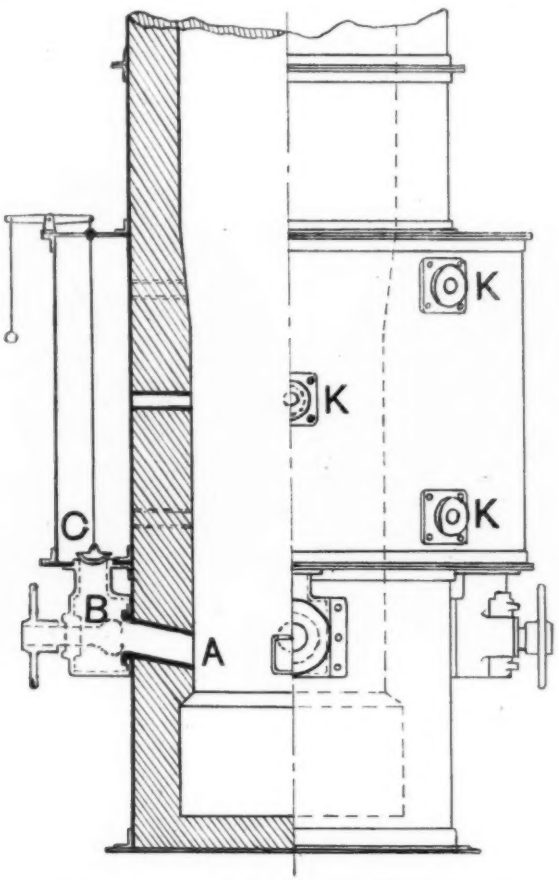


Fig. 6.—Section of the Balanced-Blast Cupola.

Grey cast iron is the cheapest and most dominant metal, and is mainly melted in the familiar cupola type of furnace. It can be readily understood that the same measure of control as obtained in other types of furnaces is not possible in the cupola where the metal is melted in direct contact with the fuel resulting in changes in the constituents of the metal, such as loss of iron, silicon and manganese by oxidation; an increase in phosphorus by concentration and in sulphur taken up from the fuel. It will also be seen that it is most difficult to produce iron of low carbon content when melting in contact with carbonaceous material, even if a high percentage of steel is introduced into the charge mixture. Not only is the chemical make-up changed, but the physical properties are very much influenced by the initial temperature of melting and the superheat imparted to the

molten iron. It is possible to obtain from two irons of similar orthodox analysis quite dissimilar physical and mechanical properties by melting and superheating to different temperatures.

Many attempts have been made to improve still further the superiority of the cupola as an economical melting unit, but there has also been much endeavour to control the chemical contents of the iron in such furnaces. It may be that both melting economy and a stricter control of the metal can be obtained at one and the same time, although economy in melting is often secured at the cost of serious injury to the properties and usefulness of the iron for pouring into moulds. It had always been thought that the best results in the cupola could be obtained by contracting or narrowing down the melting zone and blowing vigorously to form in that zone as much carbon dioxide as possible. Later the carbon dioxide and oxygen react to carbon monoxide in contact with the coke in the higher reaches of the cupola. For every lb. of carbon burned to CO_2 there would be developed 14,540 B.T.U. instead of only 4,320 B.T.U. if burned to CO only. It is in passing through the zones where carbon dioxide and free air exist that the bulk of the oxidation takes place. The difficulty of securing anything like perfect combustion and control of the metal has been very real. Such control as is obtained is too dependent on human effort. In all ordinary cupola practice the goal has been the formation of as much CO_2 as possible in the melting zone.

Poumay Cupola.

Some four or five years ago Mr. M. Poumay invented a cupola introducing a new principle (in so far that the design and system of operating the cupola aims at producing as much CO as possible in the fusion zone and lower section of the cupola), with a view to reducing oxidation of the molten drops of metal as they pass through the melting zone. The CO is burned subsequently to CO_2 above the melting zone by passing air through regenerative tuyeres introduced and located at various points above the fusion zone. Figs. 4 and 5 show respectively a photograph and a sectional drawing of the Poumay cupola. It will be noted that the shape of the cupola conforms to that of the blast furnace. There are two rows of tuyeres admitting air to the melting zone and three spiral rows starting from the larger section diameter of the lining. The results so far obtained have shown that sensible fuel economies can be obtained and also quicker melting and a higher quality metal. There is a lower metal loss from oxidation and consequently less change in the metal charged. It is also possible to secure a small reduction in the total-carbon content as compared with the ordinary cupola.

Such a cupola demands greater care on the part of the cupola operatives than the ordinary furnace. Calculated ratios of fuel, air, flux and metal burden must be adhered to within reasonable limits. Such a necessity is to be commended, as a properly-handled cupola is of tremendous importance to the success of the cast-iron foundry. Whilst this extra care may cost a little more, it is easily offset by the smaller quantity of fuel and slag, etc., to be handled. This leaves a considerable saving in fuel, less loss of metal from oxidation, and above all the provision of a more consistent metal for pouring into moulds, which can account for a far greater saving than all the foregoing points mentioned.

Balanced-Blast Cupola.

The author is permitted by Mr. J. G. Pearce, director of the British Cast Iron Research Association, to outline a new cupola—the balanced-blast cupola—developed by the Association. This cupola has been evolved under the direction of the Association's consultant, Mr. J. E. Fletcher. The Association has been granted a British protection patent No. 333,322. The cupola is the outcome of studies extending over many years in considering reactions taking place in the coke bed of the ordinary cupola and the oxidation of the metal charge. In such a cupola, Mr. Fletcher states, it is proved that gases rich in free air exist for some distance in front of and above the tuyere entrance. There will be another zone towards the core of the material, containing CO_2 and small amounts of free oxygen and nitrogen. and the central core containing principally CO.

Fig. 6 illustrates the section and general design of the balanced-blast cupola. The main principle of the furnace is to provoke a greater formation of CO in the melting zone, and by a gradual addition of further air through upper auxiliary tuyeres lead to an increase in the CO_2 and a rise in temperature until the maximum temperature zone is reached at the top of the coke bed. It will be noted that the several rows of tuyeres are fed with air from one wind belt. The main tuyeres A are controlled by ball screw valves B, so that it is possible to determine how much air is to pass through the main and auxiliary tuyeres K and to balance the blast and provide for the varying requirements of the cupola during the heat.

The main tuyere valves B are designed to allow the front of same carrying the ball valve to be swung open, enabling the free cleaning of each tuyere mouth, if necessary, when on long blows. During this operation the dish valve C is closed. The valve B is hollow and fitted with a sight glass to allow inspection of the coke bed in front of the tuyere. Air pressure can be ascertained by connecting the centre stem of the valve with a pressure gauge. The advantages claimed are a considerable economy in fuel consumption from 20 to 25 per cent. in the average case, other things being equal, and an improvement in the quality of the metal due to a reduction in the loss of the various elements and a lower sulphur pick-up from the smaller quantity of fuel used.

The Brackelsberg Rotary Furnace.

The cupola now has a rival in the economical melting of iron in a new rotary furnace, which possesses considerable advantages, in that a better control of the metal is possible, and extremely cheap irons can be alloyed to produce high-duty irons. The furnace is fired by pulverised fuel, enabling an almost complete combustion and a very satisfactory control of the chemical and physical make-up of the metal to be obtained. Various sizes of furnaces are constructed, from 1 to 50 tons capacity, to melt both ferrous and non-ferrous metal alloys. Figs. 7, 8 and 9 are photographs of the furnace. The furnace can be rotated during melting so as to be continually bringing fresh metal surfaces to be exposed to the radiation of the pulverised fuel flame which passes over the charge and does not impinge on it. It is claimed that there is sufficient velocity in the flame to carry ash into the exhaust outlets instead of falling on to and contaminating the metal. The furnace is charged by tipping to an inclined position. When in the melting position a patent burner is inserted in one of the conical ends and pulverised fuel along with primary and secondary air is admitted and ignited.

The advantages of such a furnace are as follow:—The ability to control the constituents of the metal to within fine limits, a reduction in metal loss to below 1 per cent., diminution of included gases and sulphur pick-up, economy in metal mixture by the utilisation of large quantities of cheap scrap material, and the consequent

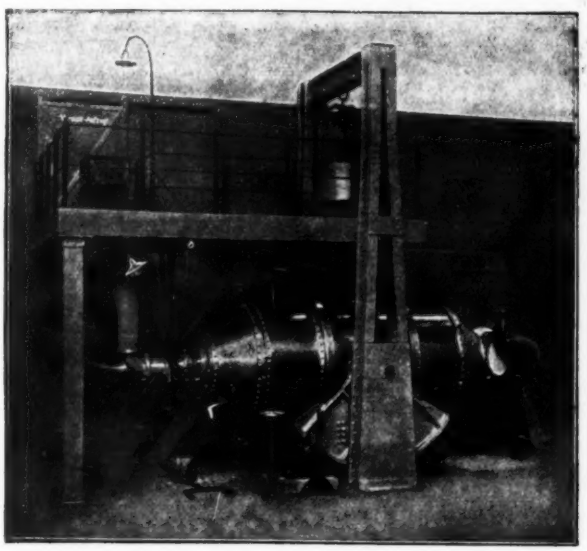


Fig. 7.—Normal Melting Position of the Brackelsberg Furnace.

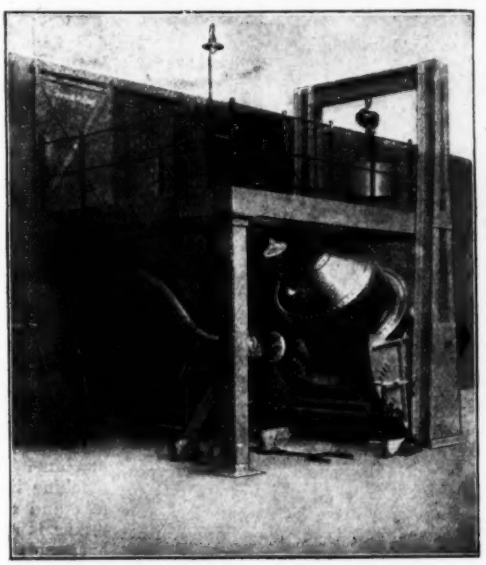


Fig. 8.—The Brackelsberg Furnace Tilted for Charging and Slag Removal.

increase in fluidity and general soundness of the metal.

Mechanical Cupola-Charging Plant.

The various methods of mechanically handling materials still leave much to be desired. This opinion was emphasised on visiting the Ford works at Detroit, where three dozen cupolas were seen to be charged by hand, although material was efficiently handled up to the point

Fig. 9.—The Brackelsberg Furnace in Vertical Position for Re-lining.

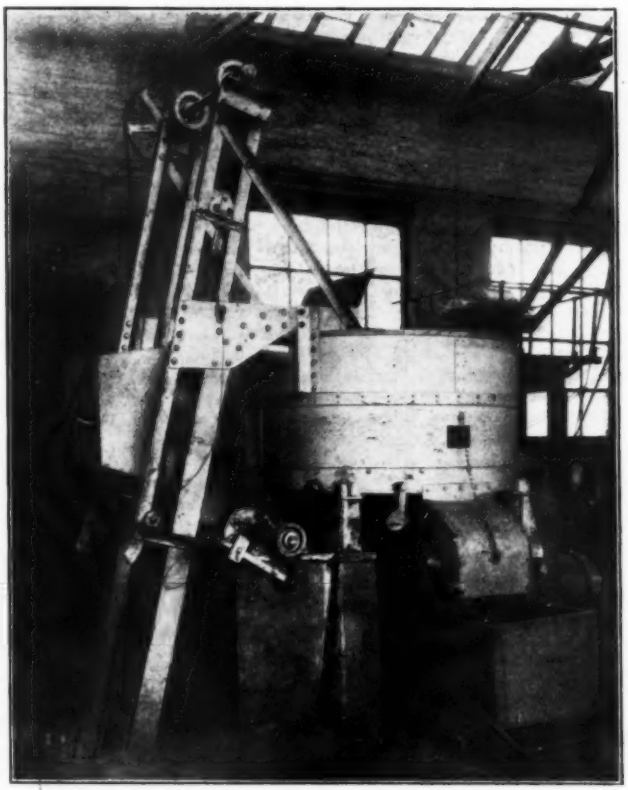


Fig. 10.—August Simpson Sand Mixer.

of actual charging. This is very significant, and agrees with the author's opinion that there is still scope for considerable improvement in cupola-charging apparatus.

The various methods employed to charge cupolas mechanically are well known. They include the use of skip hoists of various types, hydraulically-tipped trucks, and crane-charging device operating with drop-bottom buckets, but of all the schemes noted at home and abroad the most impressive method employed was practised at a large foundry in Chicago, where they used electric industrial charging trucks. The trucks are constructed to perform three distinct operations. Special charging buckets with collapsible bottoms are picked up by two arms attached to the truck. These arms, or forks, are adjustable and can be operated up or down as required. Before leaving the stock yard the material in the bucket is weighed by scales, which form part of the truck. The scales can be disengaged after weighing the material. The truck, with its load, moves on to the electric hoist, thence to the charging stage and cupola mouth, where the contents are discharged. The arms of the truck which carry the bucket protrude into the charge opening in the cupola. The material is discharged by a manipulation of the arms, which, when hoisted, engage a trip lever, which causes the bottom doors to fall and deposit the material into the cupola. The distribution of the charge is very satisfactory.

SANDS AND REFRACTORIES.

During the last decade founders have, almost unconsciously, become familiar with the regular examination and analysis of sands and refractories. Along with the knowledge gained from the chemical and physical make-up of various moulding sands has sprung up a demand for improved methods of mixing the various materials. Machinery has been devised thoroughly to mix and aerate sand without crushing the grains. Considerable economy can be secured when using modern sand-mixing plant by a reduction in the amount of new sand needed to be introduced into the mix, and in the case of oil-sand cores by a reduction in the amount of oil used. There are so many excellent machines on the market that it is difficult to single out any particular machine. The special features of the modern machine lie in its capacity and ability to bond, mix and aerate the sand. The August Simpson mixer is shown in Fig. 10. This machine is an extremely successful and modern development for producing economically-blended sand for the purpose and quantity. Further references will be made to sand-mixing appliances under "Continuous Casting Plants."

(To be concluded.)

The Brackelsberg Furnace at Bingley.

(Concluded from page 257.)

ties, has its composition controlled from a well-equipped chemical laboratory. Another item of interest is that the foundry quarries its own sand from land adjacent to the foundry, the excavations being filled in with the slag and other refuse from manufacturing processes.

In order to gauge the potentialities of the output of this Brackelsberg furnace when on continuous production, it is interesting to note that 12 tons have been melted in 13¼ hrs. The fuel consumption, which, as we have asserted elsewhere in connection with pulverised-fuel furnaces is, according to Mr. Howgate, well within the makers' guarantee of 20 per cent.

We wish to acknowledge our sincere appreciation of the co-operation accorded us by Mr. A. Howgate and his sons in the preparation of this article. In order to avoid correspondence being addressed to us, we would remind readers that the Brackelsberg furnace is handled in this country by Messrs. Brackelsberg Melting Processes, Limited, Malaya House, Trafalgar Square, London, S.W.1.

Blast-Furnace Reactions and the Production of Pig-Iron.

(Concluded from page 258.)

"Kish" Inclusions.

With reference to the micro-slide showing star-shaped cracks and graphite inclusions in the surface of chilled rolls, he would say that there was extreme danger in using mixtures containing "kishy" iron, and he was of the opinion that it would pay roll makers to encourage the "kish" to rise and be drawn off at the top of the mould. Great care was taken in Continental works to prevent the "kish" from adhering to the mould sides, and rational arrangements were made for disposing of a certain amount of excess metal which was constrained to flow off at the top of the mould. The amount of "kish" or free graphite escaping from heavy castings, when made from certain mixtures was surprising. The star cracks in the iron shown on the micro-slide were due to an excessively cold chill mould.

A vote of thanks was accorded Mr. Fletcher, on the proposition of Mr. W. A. Macdonald, seconded by Mr. Roxburgh.

The Trade Delegation of the U.S.S.R. in Great Britain announces that considerable orders have been placed recently with British firms by Soviet trading organisations in this country. The orders include a £200,000 contract with the Metropolitan-Vickers Electrical Company, Limited, for the supply of electrical equipment; an order for boiler plant to the value of £50,000 with Messrs. Babcock & Wilcox, Limited; an order with the South Wales Tinplate Corporation for tinplates to the value of £73,000; and an order with Messrs. Bruntons, of Musselburgh, for the supply of steel wire to the value of £100,000. Agreements have also been concluded recently for the supply of machine tools during the current year to the value of £100,000 with Messrs. Alfred Herbert, Limited, Coventry, and an extension of the existing agreement with the Associated British Machine Tool Makers, Limited, from £600,000 to £1,000,000.

Making a Large External Part of a Friction Clutch in Dry Sand.

By A. Greenhalgh.

Friction clutches are made in all shapes and sizes, according to the designs of the various makers and the needs of their customers. The small ones, for which there is a greater demand, are made by semi-skilled labour from plate, board or machine moulding. The medium sizes are made from a built-up pattern. The larger sizes, for which there is not the same demand, are made with strickle boards in either loam or dry sand. By this method an important saving is effected in the pattern shop, with very little added expense in the foundry. The following

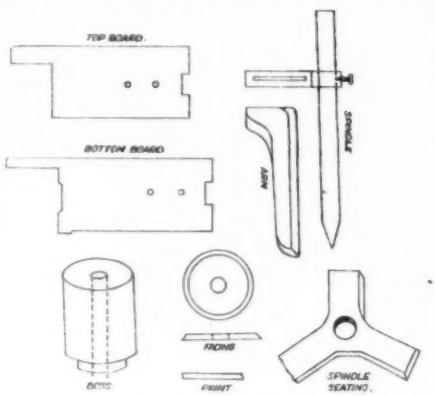


Fig. 1.—Showing the Tackle Required.

article is a description of a large one made in dry sand. The outside diameter is 72 in. The total depth from the top of the rim to the bottom of the boss is 24 in., and the weight is approximately 3½ tons.

The following is a list of requirements from the pattern shop: Loose boss with a hole through for the spindle, six arms or brackets; washer-facing with a spindle hole to form the facing in the top half over the boss; two boards, one to form the top half, the other the bottom half, and one print to be bedded-in between the

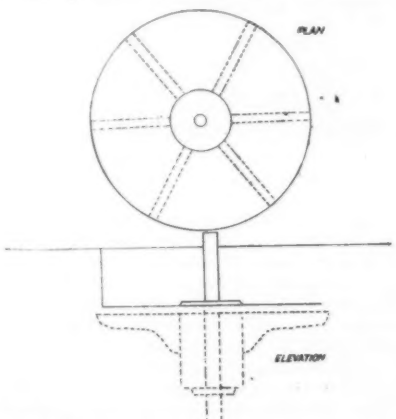


Fig. 2.—The Mould ready for the Top Half to be Rammed Up.

brackets for hand-hole cores. These, with the spindle and seating, are all the tackle required for making this job.

Fig. 1 is a sketch of the tackle. The spindle is first set perpendicularly, deep enough so that the spindle seating will be 9 in. below the bottom of the boss. The hole is then rammed up solid to the required depth for the boss. A spadeful of facing sand is now placed round the spindle and levelled down, and upon this is bedded the boss, which after being bedded solid should be tried out, the bottom made good and well sprigged. It is better to do the sprigging at this stage, because it would be very awkward to reach to the bottom of the boss for that purpose when finishing the mould. The boss is now put back in position and a good thickness of facing sand placed round the bottom for a depth of 6 in.; this should be made very solid round the boss.

A cinder bed 4 to 6 in. deep can now be put in the same diameter as the mould, the pipe being placed so far back that there is no risk of it being in the way of the strickle boards or top part. The boss can be rammed to the top, being lined with facing sand as this takes place. The board for forming the top half can now be placed on the spindle, by which means a black-sand bed can be made level with the top of the boss. The six arms can now be bedded in posi-

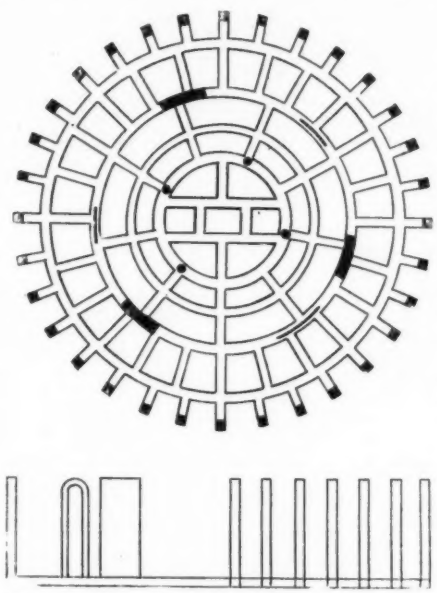


Fig. 3.—The Grid, showing Position of Staples, Prongs and Scotching-Blocks.

tion. The first one can be bedded-in on any straight line from the spindle; the second one is set on the same line running at the opposite side of the spindle. These can easily be set with the use of a spindle straight-edge, which is an ordinary straight-edge recessed out to allow it to fit half-way round the spindle and so give the exact centre line. The other four can be set with a set of trammels and the straight-edge. These arms should be bedded and rammed up in facing sand, as they have no need to be disturbed until they are drawn out to finish the mould.

The top-part board can now be put on the spindle again. It must not rest upon the boss or arms, but should be set that distance away to give the thickness of the plate, which in this case is 2½ in. So if a block of wood 2½ in. square is placed upon the boss and the board lowered so that it just touches the block without holding it, it will give the correct thickness. The sides and bottom are now made solid in black sand; the board is then worked round and the sand is strickled off to the correct shape.

The board can now be taken off, the mould made good and smoothed up; parting sand is thrown over, and the joint is now made. The facing or washer is placed over the spindle to form the recess in the top. Fig. 2 gives a plan and elevation of the mould. The lift in the top being a fairly big one, a grid is made for this purpose, instead of gaggers. By this method the lift or cod can be rammed up before the top is put on; by this means the moulder can ram it up much easier and quicker. Fig. 3 is a sketch of the grid, which can be stamped out upon an open sand bed. Prongs are cast on the grid the depth of the lift, and also three wrought-iron staples to fasten the grid to the top. Three scotching-blocks are also cast on to fasten the grid to the bars of the box. If this were not done, the action of screwing the grid up to the top would pull it out of position.

Facing sand is now placed over the bottom, about 1 in. in thickness, and upon this is bedded the grid, which must be knocked down until it is solid. The sand is then rammed tightly under any portion of the grid where the sand is

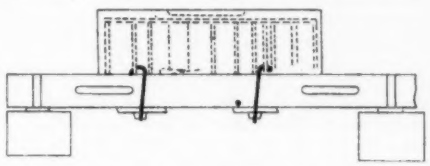


Fig. 4.—The Top Half of Mould.

soft. Runner pegs are placed upon the top of the boss. After the lift has been rammed half-way up, the sides of the lift are lined with facing sand 2 in. thick to the top of the joint and patted tight with a piece of flat iron. It is now vented and cinders are put in, two pegs or pipes being stood up to come through the top part to carry off the gases. The lift can now be rammed to the top, loose irons being inserted in such places as are found necessary for strengthening purposes. The flat portion of the joint is made good, parting sand being thrown on, and the job is ready for the top part. This part being placed in position, packing is placed between the scotching-pieces and the box bars; these are made tight with wedges. Hook-bolts are connected to the staples, and the grid is screwed tight to the top part. A good riser peg is set on the rim and the top rammed up, staked and ready for lifting off. When this is done it will be found that a good portion of the bottom part has been torn away. This is no detriment, as it would have to be cut away

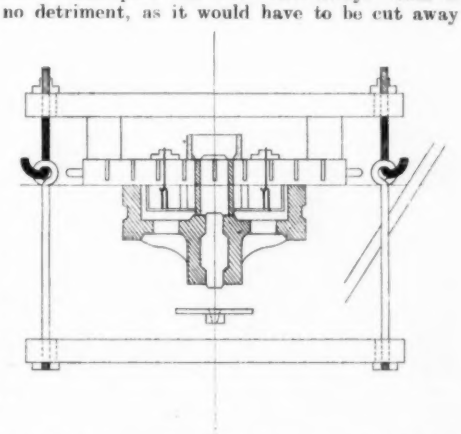


Fig. 5.—Sectional View of Mould ready for Casting.

in any case. Fig. 4 gives a sketch of the top lifted off.

In finishing this part, care must be taken in making good any broken parts to allow enough for machining; this applies chiefly to the sides of the lift. After having been made good, it is given a good, thick coat of blackwash and sleeked up; this half is then ready for the stove. The black sand covering the boss and

(*Continued on page* 265.)

The Degasification Process.

By J. E. Hurst.

The presence of gases in many commercially-prepared metals and alloys in the solid state is beyond dispute. Probably one of the earliest demonstrations of the presence of such gases is due to Count Runford, who showed the gases liberated by boring cast cannon under water. During recent times the attention of numerous metallurgists has been devoted to the extraction, examination and determination of the influence of dissolved gases in metals and alloys.

Early Experiments.

The influence of dissolved gases on the properties of cast metals as yet is by no means clearly defined. The consideration of their influence is divided generally into two parts:—(*a*) Their influence in promoting unsoundness in the finished casting, and (*b*) their influence on the physical and mechanical properties of the material. From the foundryman's point of view, any influence that dissolved gases may exert in promoting unsoundness is by far the worst aspect. Unfortunately, quantitative evidence of the

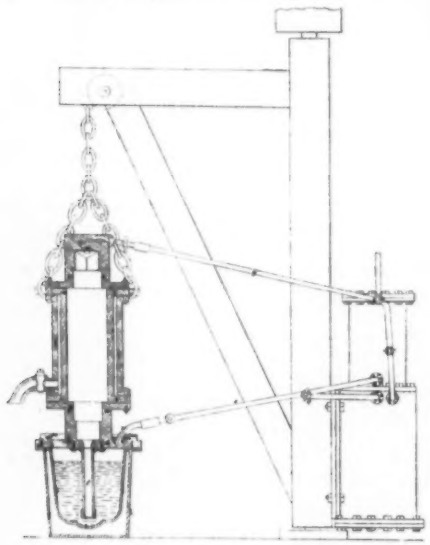


Fig. 1. Church's Apparatus for the Production of Sound Castings (1850).

influence of dissolved gases in promoting unsoundness is by no means easy to obtain. On the other hand, the belief in their influence in this direction is of very long standing. The age and persistence of this belief cannot be better illustrated than by reference to the various methods, systems and devices which have been proposed from time to time with the object of promoting and ensuring soundness in castings and cast metals. From quite an early date, a variety of methods of a mechanical or semi-mechanical nature have been proposed for this purpose. As early as the year 1818, James Hollingdrake described methods of promoting soundness and closeness in copper roller castings, utilising pressure applied to the surface of the molten metal before and during solidification. Pneumatic and hydro-mechanical devices were employed to generate the necessary pressures. (See British Patents Nos. 4,287 and 4,371, A.D. 1818.) The application of pressure to the solidifying metal has been resorted to by numerous inventors. In more recent times, there are applications of such processes for the promotion of sound steel ingots, *e.g.*, the Whitworth and Harmet process of fluid compression. Nasmyth, the inventor of the steam hammer, suggested the sudden application of very great pressures to the metal before it was cooled, utilising an apparatus constructed on the principle of a steam hammer. (British Patent No. 13,261, A.D. 1850.) Everitt, in 1857, applied hydraulic pressure to the outside of the mould "so as to close it and press the metallic particles together." (British Patent No. 3,085, A.D. 1857.) Even the early applications of the centrifugal process had as their object the promotion of soundness, this being understood to be brought about by the condition of centrifugal pressure. At least one centrifugal process in operation to-day refers to its product as "fluid compressed."

A method which takes several forms is described by Church (British Patent No. 5,084, A.D. 1850), and has for its object the casting of metals "more sound and free from air holes." The method is described in its application to the casting of a chilled roll. The mould, consisting of a hollow metal cylinder, is suspended about its vertical axis. The lower end of the mould is equipped with a tube of refractory material, which dips into the ladle containing the molten metal. The upper end of the mould is connected with an air-exhausting pump, and the ladle is contained in a suitable chamber to enable a pressure of air being created above the surface of the metal. The mould is thus filled with metal under the combined influence of the pressure above the surface of metal in the ladle and the partial vacuum within the mould. (See Fig. 1.) An almost similar process is described in Patent No. 995, A.D. 1853, as having for its object the production of "castings of iron or other metals" free from air bubbles or impurities of any kind. The patents of Jenkins (1855, No. 495) and Bell (1864, No. 2,831) are further examples of almost similar applications.

To prevent the "formation of air cells in the castings," Thomas J. Chubb advises that previous to and while filling the mould, the air should be excluded therefrom by admitting only a current of gas from a gas generator. (British Patent No. 3,203, A.D. 1866.)

Another method of promoting soundness in castings resorted to was the use of heated moulds. Adcock in 1856 took out a provisional patent under the title of "An improvement in casting iron and other metals," in which it is recommended that "the metal is cast in highly-heated moulds, which may be made of sand." Riepe, of Pau, France, took out a British provisional patent, No. 2,115, in 1858, in which he states that "it is proposed to prevent the formation of bubbles or honeycomb in steel by heating the mould in any convenient manner prior to pouring." Other similar examples of this application could be quoted readily.

The Work of Bessemer.

Whilst they are primarily concerned with the production of sound steel, the efforts of Sir Henry Bessemer, as illustrated by a series of patents, are most illuminating. These patents present in outline an idea of the stupendous efforts made by him to overcome unsoundness in the early product of his pneumatic process. His first patent which has reference to this subject, No. 630 of the year 1856, provided for an airtight mould, capable of being exhausted from the upper end. The lower end was immersed in the molten metal in the ladle, and on exhausting the mould the molten metal was sucked up "free from contact with air." Thus, the tendency of "cellular ingots was diminished." In the same year, Patent No. 1,252 provides for the reverse conditions, in which the molten metal was calculated to be forced up into the mould by means of compressed gas. In this case a sand-lined mould was recommended to allow of the "disengagement of any gases." A further proposal was embodied in Patent No. 2,639 of the same year, which provided for the agitation of the molten metal, with fluid slag, fluxes or purifying agents, such as slag from the blast furnace, with lime, clay, silica or certain alkaline salts. The operation was designed to be carried out in a cylindrical wrought-iron vessel with hemispherical ends, lined and mounted on a slide or suspended on a rocking frame.

Three years later, in 1859, a more violent method of agitation was proposed by Sir Henry Bessemer in his patent No. 2,819. Here it was proposed to pour the metal on to a rapidly-rotating table or surface, rotating within the enclosure of a mould casing. Under these conditions, by reason of the centrifugal action, the molten metal was "thrown outwards in the state of globules; the extrication of gaseous matters from it being thereby favoured." The outer revolving mould enclosure formed the mould where the globules collected. In the same document, it is related that "when producing ingots without using centrifugal force, gaseous matters are to be as much as possible disengaged from the metal by pouring the latter on to a projection in a lined iron vessel, or a red-hot fireclay vessel, placed over the mould, whereby

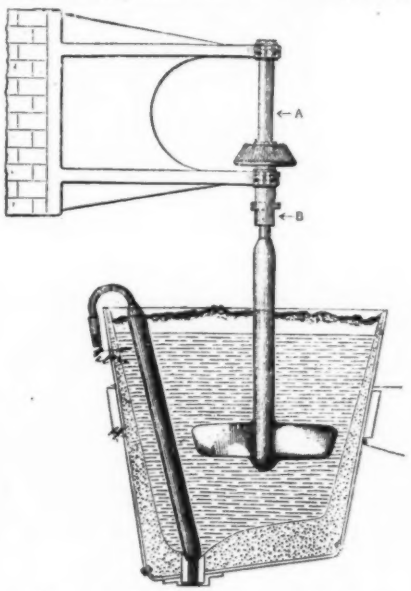


Fig. 2.—The Mechanical Stirrer of Bessemer (1863).

the stream of metal will be divided into globules, which collect in the lowest part of the vessel and pass through it into the mould." In a later patent taken out in 1863, still a further method of degasifying and thorough mixing of the molten steel was provided for by violently agitating the metal carried in a ladle, by means of a twin-bladed propeller, coated with refractory material and inserted into the molten metal. An illustration of this is given in "Metals," by Bloxam (London, 1885), and is reproduced in Fig. 2. This same method was proposed in 1858 by another famous inventor, Shrapnel, and is recorded in a provisional patent application No. 1,343. It is, of course, well known that Bessemer overcame the difficulties in the production of sound steel by entirely different means; but, apart from the question of the success or failure which attended his many mechanical proposals, they serve to show the realisation of the part played by the gases in the steel.

The difficulties of unsoundness experienced by Bessemer were largely overcome by the use of silico-spiegel and the adjustment of the silicon and manganese contents. The production of sound steel is ensured by the correct adjustment of the composition, the use of deoxidisers such as

aluminium or ferro-titanium and the control of factors such as casting temperature and teeming speed, which influence the rate of cooling. Of the metallurgists and investigators who have contributed to the knowledge of the methods, conditions and principles underlying the production of sound steel, it is impossible to pass over this opportunity of paying tribute to the monumental works of Brinell.

Examples from Non-Ferrous Metallurgy.

In the case of non-ferrous alloys, similar methods, utilising deoxidisers, of which phosphor-copper and boron-copper are typical examples, control of the casting temperature are resorted to for the production of soundness in castings. Of recent years, in the case of aluminium alloys in particular, the association of the presence of dissolved gases with unsoundness in the castings has led to the study and devising of special methods of promoting soundness having for their object the removal or minimising the influence of these dissolved gases. These methods are described by Archbutt ("J. Inst. of Metals," No. I, 1925), and are best described in this author's own words: "It appeared that if solidification was sufficiently rapid as in a metal mould, the occluded gases in the melt were not liberated but retained in solution in the solidified alloy. If solidification were sufficiently slow, the gas was liberated and enabled to free itself from the solidifying melt, while at intermediate rates it was liberated from solution but entrapped in the form of minute bubbles, causing pin-holing. It appeared probable, therefore, that if a melt were slowly solidified it would largely rid itself of occluded gas, and that castings poured from the remelt would exhibit improved soundness providing that not much fresh gas was absorbed in remelting. Experiments on these lines were immediately successful." This method, which has now come to be known as the "pre-solidification method" of promoting soundness in aluminium alloys, is a deliberate attempt at degasification. The experimented work of Archbutt on presolidification was simplified by passing through the slowly solidifying metal a stream of inert gas (nitrogen), with the object of removing small bubbles of gas entrapped in the solidifying metal.

This treatment was also successful. The effect of bubbling a stream of gas through a solidifying metal in removing dissolved gases is due to its effect in reducing the partial pressure of the gas locally within the metal and also to the agitation within the metal produced by the stream of gas. Other methods have been devised for use with aluminium alloys in which chlorine gas is bubbled through the metal.

The Case of Cast Iron.

Viewed broadly, it is probable that of all the alloys which are founded, cast iron is the one which is least liable to trouble due to unsoundness. Nevertheless, the troubles which do arise from unsoundness in cast iron are no less serious or difficult to deal with. With cast iron, the importance of control of casting temperature in promoting soundness has been realised, and, broadly, this control is the most important factor in the production of sound castings. With the object of still further assisting the production of sound castings, several types of mechanical degasification processes have been devised. Of these, considerable prominence has been given to what is described as the shaking or jolting receiver. This apparatus, invented by the Continental engineer, Duchesne, has been described by Irresberger ("F.T.J.," July 22, 1926). In the most advanced design it takes the form of an oil-fired receiver, suitably mounted on a frame and arranged to be capable of being jolted by means of a rotating cam device, very similar in action to that of a mechanical jolt-ramming machine. The effect of a quick succession of jars on the molten metal contained in the receiver is claimed to effect considerable improvement in the quality of the castings produced, and this is ascribed partially to the degasification effect.

The Bradley degasification process is applied to the production of high-grade, refined pig-iron. In this process, which operates in a large unit, treating quantities of from 10 to 15 tons at a time, the metal is taken from the furnaces or refineries for treatment. The degasification plant is illustrated in Fig. 3. It consists of a large cylindrical furnace fired by means of oil burners. Grade 1 fuel oil is used, and the metal taken from the refineries is maintained at a suitable temperature for the degasification process. This process is effected by the introduction of a powerful stirring device lowered into the metal after the removal of the furnace roof. This device consists of four vertical rods, coated with a suitable refractory coating and arranged to rotate in the metal at a constant speed of different radii. The period of time to which the metal is subjected to this agitation is dependent upon the character and the amount of metal to be treated. The agitation produced is of a violent character and the molten mass of metal acquires a rotational velocity of at least 400 ft. per minute.

The effect of the violent agitation and rotation of the metal, in addition to ensuring thorough mixing of the metal, tends to eliminate a good deal of the dissolved gas content and suspended undissolved impurities. The effect of this is quite distinctly apparent in the improved running properties and increased "life" of the liquid metal. The introduction of this process is due to the research staff of Messrs. Bradley & Foster, Limited, Darlaston, at whose works the plant is in constant operation. In its application to pig-iron this process marks the first attempt to apply degasification processes to the production of pig-iron.

Fig. 3.—Bradley's Degasification Apparatus.

Making a Large External Part of a Friction Clutch in Dry Sand.

(*Concluded from page* 263.)

arms is now dug away, also about 1 ft. all round the sides. A pulley ring or a radius block must now be used for ramming-up the sides, which must be thickly lined with facing sand and ironed. The spaces between the arms should now have the black sand scraped out to the depth of 1 in. The strickle board for forming the bottom can be placed in position—that is, so that it can be worked round in such a manner that it just clears the boss and arms. Before the board is worked, the bottom can be well vented and the holes made up. The board is now worked round, the facing sand falling from the side being utilised for making the bottom good. When this is done the board is taken away.

The print for the hand-hole cores can be now bedded in equally between the arms. The boss and arms are drawn out and the mould finished and black-washed. The hand-hole cores can be placed in the mould when finishing; this saves a little chipping in the fettling shop. Moreover, they are also supports for the basket fires when drying. For drying the boss, a round block can be rammed up upon sand; a staple cast in the end for lifting purposes makes an efficient drying arrangement. The heat from the fires does not generally reach to the bottom of the boss. When dry, the mould is thoroughly cleaned out, the centre core for the boss is placed in position and the job is ready for the top going on, the top being tried on to see that there is a nice touch round the joint and cores. The runner and riser are now made up, and the top weighted; the job is ready for casting.

For jobs of any size and weight it is always advisable to have a pit; that is, when binders are placed across the bottom of the hole, these are connected to binders across the top part by long bolts which can be screwed up tightly. This arrangement, besides being safer, does not necessitate the same number of weights lying about the shop, taking up room. Fig. 5 shows a sketch of the mould ready for casting, binders being used to hold down the top.

Trade Talk.

Moler Products, Limited, have removed to 42, Kingsway, London, W.C.2, from 49, Moorgate, London, E.C.2.

A cast-iron pipe foundry, to be known as the Krainische Industriegesellschaft, is to be constructed at Feistritz, Jugoslavia.

The British Aluminium Company, Limited, have commenced operations in connection with the second stage of the Lochaber hydro-electric scheme.

The Ford Motor Company have constructed a plant at Cologne, Germany, which will commence operations on April 19, and will employ about 2,000 workpeople.

A fire occurred on March 25 at the premises of Messrs. Hattersley (Ormskirk), Limited, engineers and brassfounders, of Springhall Lane, Halifax. The outbreak was confined to the patternshop.

Messrs. John Cartwright & Sons, Limited, New Bond Street Ironworks, Birmingham, have arranged to amalgamate their business with the Hill Top Foundry Company, Limited, West Bromwich.

Messrs. Ruston & Hornsby, Limited, of Lincoln, have booked an order for a six-cylinder Ruston vertical airless-injection cold-starting oil engine, of 600 b.h.p., from the Elgin Electric Supply Company, Limited.

Messrs. Lithgows, Limited, Port Glasgow, have secured an order for a high-class passenger ship for Jugoslav owners. The only other vessel building for Jugoslav owners at present is a large flotilla leader in course of construction by Messrs. Yarrow & Company, Limited.

The War Office has placed a contract for a complete boiler unit for Woolwich Arsenal with Messrs. John Thompson Water Tube Boilers, Limited, Wolverhampton. The London County Council have placed a contract with the same firm for two complete boiler units for London County Hall.

Following on orders for railway material recently distributed by the Southern Railway Company, the L.M.S. Company are understood to have divided contracts for about £60,000 worth of rails among Messrs. Dorman, Long & Company, Limited, the Cargo Fleet Iron Company, Limited, and Pease & Partners, Limited.

The engineering works of Messrs. Lingford, Gardiner & Company, Limited, at Bishop Auckland, are to be closed, the directors and shareholders of the company having sold their interest and holding to Mr. Maurice V. Summerson, of Messrs. William Blackett & Company, Limited, sawmillers and timber merchants.

The President of the Board of Trade last week, received a deputation from the Shipbuilding Employers' Federation, who wished to lay before him the position of the shipbuilding industry in relation to the placing of orders for ships by the Soviet Government. The President promised to consider the points put to him by the deputation.

The Greenock Dockyard Company, Limited, have launched a single-screw motor-driven oil tanker, "British Energy," for the British Tanker Company, Limited, London. She has a deadweight of 10,100 tons on 25½-ft. draft, and is built for the bulk carriage of petroleum. Messrs. John G. Kincaid & Company, Limited, Greenock, supplied and installed the machinery.

The annual statement of the United States Steel Corporation for the year ended December 31, 1930, shows the following results:—Gross receipts, $1,180,935,000 (previous year $1,493,505,000), total earnings $157,710,000 (against $265,839,000), net earnings $104,422,000 ($195,448,000), surplus net income $18,836,000 ($108,523,000); the yearly dividend of 7 per cent. on the common stock absorbed $60,366,000 ($63,849,000).

An extraordinary meeting of shareholders of the English Crown Spelter Company, Limited, at Swansea on Friday, March 20, unanimously approved a resolution to wind up the company voluntarily, and ratified a provisional agreement for the sale of goodwill, leasehold and other property of the company, together with fixed plant and machinery, to the Austral Development Company, Limited, for £50,000.

Seven German iron and steel companies—the Vereinigte Stahlwerke A.G., Abteilung Westfäl. Union, Hamm; the Westfälische Drahtindustrie, Hamm; the Gutehoffnungshütte Oberhausen; Hoesch-Köln Neuessen A.G., Dortmund; Felten & Guilleaume, A.G., Köln; Klöckner-Werke, Düsseldorf; and the Vereinigte Oberschlesische Hüttenwerke A.-G., Gleiwitz—have formed a Cartel to control the market in oval steel wire and cable wire. These two products are mainly sold abroad.

The Falkirk Iron Company Welfare Club completed its winter programme on March 27, when prizes won in club competitions during the year were presented by Mrs. H. J. Kennard. Mr. George Scotland, director and commercial manager of the company, presided, and apologised for the unavoidable absence of Capt. H. J. Kennard, R.N., through illness. He gave a *résumé* of the club's activities during the past session, and, referring to the depressed times that the ironworks in Falkirk and district were experiencing, said that, if they were to pull through, they would require to stand by one another. Falkirk had assets, and the Falkirk Ironworks held one of the supreme places among the ironworks of the country. The iron trade was by no means finished, and sooner or later Falkirk would flourish.

Mr. A. S. Murdoch, chief engineer to the Shotts Iron Company, Limited, recently arranged for the firm's apprentices to visit periodically the works of other companies in the West of Scotland. On March 26 a party of 51 apprentices from the various departments of Shotts Ironworks visited the Clydesdale Steel Works of Messrs. Stewarts & Lloyds, Limited, at Mossend. They were conducted over the works by Mr. Carmichael, welfare supervisor at Mossend, who, after the inspection, emphasised in an address that the visit was not to be regarded as an afternoon outing, but as a lesson which should prove of value in the future. Mr. Hanley, who was in charge of the party on behalf of the Shotts Iron Company, Limited, thanked Mr. Carmichael and the directors and officials of Messrs. Stewarts & Lloyds for their co-operation, and stated that the visits were intended to encourage the lads to attend evening classes, and only those who did so were allowed to participate.

The British Thomson-Houston Company, Limited, Rugby, have obtained repeat orders from the London Electric Railway Company for 17 mercury-arc rectifiers of 1,500 kw. each and five of 2,000 kw. each. These rectifiers, which are of British design and manufacture, will be installed in nine substations, for which the complete B.T.-H. equipment will include, in addition to the rectifiers, over 100 air-blast transformers, 120 high-speed circuit breakers, and 60 heavy-duty oil circuit breakers. In all cases the rectifiers will be provided with automatic control gear for remote operation. This is the largest order for mercury-arc rectifiers placed in this country. The British Thomson-Houston Company also has in hand the manufacture of two 1,200-kw. mercury-arc rectifiers for the L.M.S. Railway Barking-Upminster electrification scheme, while a B.T.-H. rectifier will shortly go into service on the Manchester-Altrincham Railway, the electrification of which is nearing completion.

New Companies.

Union Metals, Limited, Union Street, Coventry.—Capital £1,000. Directors: C. H. G. Simmons, J. Beddow and J. Blackwell.

Seiffert (Great Britain), Limited, 92, Cannon Street, London, E.C.—Capital £25,000. Iron and steel tube merchants, etc. Directors: P. S. Brown, G. A. Tawse and E. W. H. Fairbairn.

Peters Engines & Aircraft, Limited.—Capital £5,000 (4,000 £1 10 per cent. cumulative preference and 20,000 1s. ordinary shares). Subscriber: J. A. Peters, 30, Caldecote Street, Newport Pagnell.

Obituary.

Captain T. J. Tresidder, who for many years was a director of Messrs. John Brown & Company, Limited, died on Friday, March 20, at the age of 81.

A well-known figure in Falkirk foundry circles, Mr. John Walker Telfer, for many years with the Camelon Iron Company, Limited, died at his home in Falkirk on April 2.

The death has occurred at his residence, Cassillis House, near Ayr, of Mr. John Strain, C.E., who founded and was for many years chairman of the Lanarkshire Steel Company. Mr. Strain was in his 86th year.

Mr. R. R. Bevis, for many years managing director of Messrs. Cammell Laird & Company, Limited, Birkenhead, died on March 21, in his 77th year. Mr. Bevis was appointed managing director and general manager of the company in 1900, and held this position until his retirement in 1912.

Personal.

Mr. W. F. Prentice, of Saltburn, has been appointed a director of Messrs. Redpath, Brown & Company, Limited.

Dr. Voegler, the German industrial leader, has been appointed President of the Alpine Montan Steel Corporation, of Austria.

Mr. A. Linney Arnold, Mr. John Ferguson and Mr. Arthur M. Lamb have resigned from the board of the Lancashire Steel Corporation.

Mr. S. W. Rawson has been appointed secretary of Messrs. Dorman, Long & Company, Limited, in succession to the late Major J. D. H. Stubbs.

Mr. George Alexander Calder has been appointed chairman of Messrs. Joseph Rodgers & Sons, Limited, Sheffield, in succession to the late Mr. Robert Leader.

Mr. Colin Presswood, B.A., of Bolham Hall, Retford, resigned his position as technical manager to General Refractories, Limited, of Sheffield, on March 31, having filled this position since March, 1925.

Eng. Lt.-Commander J. Burnard Bullock has resigned the editorship of the "South African Engineer and Electrical Review," and has joined the staff of the Union Steel Corporation (of South Africa), Limited.

Mr. John H. Amos, general manager and secretary of the Tees Conservancy Commission, has intimated that he desires to retire. He has occupied the position for more than 40 years. Mr. Amos is in his 82nd year.

Mr. F. H. Brooke, managing director of the Oughtibridge Silica Firebrick Company, Limited, was installed as the new President of the Refractories Association of Great Britain at the annual meeting in Sheffield on March 27.

Mr. John E. James, of the Cargo Fleet Iron Company, Limited, has been nominated by the Securities Management Trust to act as chairman and managing director of the Lancashire Steel Corporation, Limited, in a whole-time capacity.

Mr. Cyril Watts, chairman of the Management Committee of the London Iron and Steel Exchange, has been appointed secretary of Messrs. Richard Thomas & Company, Limited, and subsidiary companies. Mr. Watts will continue to act as director and secretary of the South Wales Tinplate Corporation, Limited.

Mr. John A. Hopkinson is joining the board of directors of Messrs. Jonas & Colver, Limited, Novo Steel Works, Sheffield. Mr. Hopkinson spent several years in America as representative of Messrs. Sanderson Bros. & Newbould, Limited, prior to joining the Colonial Steel Company, of Pittsburgh. He resigned from that connection 16 years ago in order to join Messrs. Hall & Pickles, Limited, and is now relinquishing his position there as technical sales manager in order to take up his new post.

Wills.

Caddick, W. A., secretary and director of the Cargo Fleet Iron Company, Limited, Middlesbrough	£8,090
John, E. T., joint managing director of the Linthorpe-Dinsdale Smelting Company, Limited, Middlesbrough ...	£36,899
Musgrave, H. T., head of Messrs. Musgrave Bros., hydraulic engineers, Leeds	£30,483
Bull, Rt. Hon. Sir William J., chairman of Messrs. J. W. Singer & Sons, Limited, metal workers and bronze founders, Frome, and a director of Messrs. Siemens Bros. & Company, Limited	£30,856

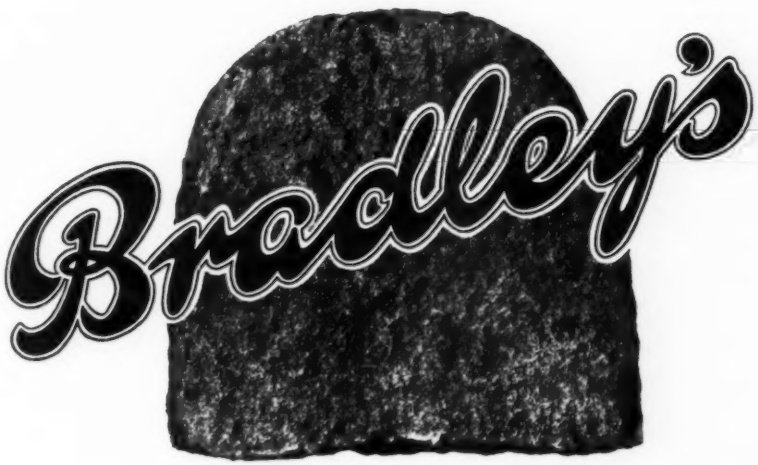
Reports and Dividends.

G. D. Peters & Company, Limited.—Gross profit, £17,637; depreciation, £11,121; interest, £5,886; net profit, £630; no dividend is recommended; carried forward, £15,254.

Hadfields, Limited.—The directors have decided not to pay a dividend on the ordinary shares for the year ended December 31 last. The dividend on the 4½ per cent. cumulative preference shares has been paid as usual.

Associated Portland Cement Manufacturers, Limited.—Net profit, £387,650; brought in, £140,899; preference dividend, £127,585; ordinary dividend of 8 per cent., £240,000; carried forward, £160,964.

THE ORIGINAL MAKERS



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PIG IRONS
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ALL CLASSES OF
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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The output of pig-iron is so restricted that only a very small improvement is needed to have an immediate effect upon the market. The very slight improvement which was apparent over the holidays had, therefore, the effect of making the market appear less depressed. Consumers' needs are undoubtedly on an increased scale, and, as prices do not seem likely to fall further, a few contracts have been placed covering the period to the end of June. This is especially gratifying after the prolonged period of hand-to-mouth purchasing. Ironmasters in this area are still turning the bulk of their output into the local steel furnaces, and the rest is chiefly absorbed in local or inland deliveries. Export sales are sparse and of small extent, and if better deliveries have been made to Scotland during the past week, the bulk of the Scottish trade is still in the hands of foreign producers. Cleveland's pig-iron prices are specially reduced to Scottish consumers, but to all other destinations the fixed minima are:—No. 1 foundry iron, 61s. per ton; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton.

The East Coast hematite trade fails to show any improvement. Deliveries to Sheffield and South Wales are still far below normal, and buyers are dealing chiefly in small parcels for near delivery. Although the output of hematite on the East Coast is now extremely small, prices continue to show a weak tendency. Mixed numbers are now quoted at 67s. per ton, but substantial concessions are no longer obtainable. It may still be possible to shade slightly the quoted price, but certainly not to the extent which was possible a week or two ago. Sellers are quoting 67s. 6d. to 68s. for forward sales on the assumption that the cost of raw materials is likely to advance.

LANCASHIRE.—In this area trade has been small owing to the holiday influence. Most users had covered their requirements in the early part of March, so that little fresh material was bought. There is a general belief, however, that conditions in the consuming trades are less depressing than they have been and sellers are looking with some confidence to a resumption of buying operations fairly soon. In the meantime, there have been few alterations in prices. For delivery to users in the Manchester price zone, Staffordshire and Derbyshire brands of No. 3 are at 69s. 6d. per ton, with forge quality at 64s. 6d., Northamptonshire foundry iron at 68s., North-East Coast iron at the Midland zone rates, Scottish brands at from about 89s. to 90s., and West Coast hematite iron at around 82s. 6d. per ton.

MIDLANDS.—The general situation is unchanged. Most of the ironfounders are badly in need of fresh work, and, consequently, they refuse to be interested in forward supplies. Forge pig-iron is still in poor demand. Buying in the hematite market is still confined to small tonnages for immediate needs. No alterations in prices have been made, so that the figures quoted by the furnaces for delivery to Birmingham and Black Country stations are 67s. 6d. for Northants No. 3 and 71s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—A reduction of 2s. per ton in hematite mixed numbers has been made by the Scottish pig-iron makers, bringing the quotation down to 72s. f.o.t. steelworks. Scottish foundry iron is at 73s. 6d. per ton, f.o.t. furnaces, with a minimum of 2s. 6d. per ton extra for No. 1. For Middlesbrough iron there is little demand. Continental No. 3 can be obtained at 53s. f.o.t. Grangemouth, and Middlesbrough No. 3 at 60s.

Finished Iron.

This market remains unusually quiet, and trade, especially in crown and the cheaper grades of iron, shows no signs of improving. There is not sufficient work available to keep the mills occupied regularly, and there is much price-cutting from the works for what business is developing at the moment. Crown bars are at from £9 5s. up to £10, and nut and bolt bars from £8 12s. 6d. to £8 15s. Staffordshire marked bars remain stationary at £12 10s. at works, and the makers of this type of iron, although better situated for work than those dealing with the cheaper brands, are anything but well placed, and could do with much more work than is at present forthcoming. For nut and bolt work the bulk of the supplies being used comes from the Continent owing to the disparity in price. No. 3 Belgian iron can be obtained freely at £4 15s. to £4 17s. 6d., delivered Black Country works.

Steel.

Finished steel is in poor demand, as constructional engineering and shipbuilding, on which the finished-steel works so largely depend for orders, are still buying only sparingly. The railways have placed a few more orders, and the rail mills are moderately well occupied. The demand from locomotive builders and boiler makers is still below normal. The demand for small steel bars is poor and prices are not firmly held. Continental prices for semi-finished steel are becoming firmer, although so far there has been no great increase in business. No further decline in British prices has taken place, although there is no doubt that some concession would be made in order to obtain any substantial order.

Scrap.

Business in the iron and steel scrap markets generally has been slack. There is perhaps a little more optimism prevalent in Cleveland, but deliveries have been retarded, and no new inquiries are on the market. The quotation for ordinary-quality cast-iron scrap is 47s. 6d., while good machinery quality is worth 49s. In the Midlands, the depression is unrelieved in any way. The price of good heavy machinery cast-iron scrap in cupola sizes is 57s. 6d., and light cast iron is at 37s. 6d. Scottish business is still slow. Stocks at the works are still high, and even merchants are holding greater quantities of scrap at their yards than usual. First-class machinery metal, in pieces not exceeding 1 cwt., is quoted at 51s. 6d. to 52s., while ordinary cast-iron scrap to the same specification is at 47s. 6d. to 48s. 6d. The above prices are all delivered consumers' works.

Metals.

The London Metal Exchange was closed after the morning 'Change on Thursday, April 2, until the morning of Tuesday, April 7. During the past week the non-ferrous metal markets were restricted by holiday influences. Dealings were limited, and it is difficult to judge accurately the trend of these markets during the period under review.

Copper.—There has been very little activity in the copper market. Conditions of world trade seem to be even worse, and it is difficult to see where any sustained buying can come from unless consumers' order-books are much improved.

Closing quotations :—

Cash.—April 1, £43 7s. 6d. to £43 8s. 9d.; April 2, £43 2s. 6d. to £43 5s.; April 7, £42 16s. 3d. to £42 18s. 9d.; April 8, £42 11s. 3d. to £42 12s. 6d.

Three Months.—April 1, £44 1s. 3d. to £44 2s. 6d.; April 2, £43 15s. to £43 16s. 3d.; April 7, £43 10s. to £43 12s. 6d.; April 8, £43 5s. to £43 6s. 3d.

Tin.—The market is very quiet and uneventful. Sellers remain cautious, and support is given when there is any sign of prices weakening. The quota scheme so far has not influenced prices to any extent. The consuming trades are far from being busily occupied, the tinplate industry, in particular, experiencing a poor demand for its products.

Official closing prices :—

Cash.—April 1, £119 15s. to £119 17s. 6d.; April 2, £119 5s. to £119 7s. 6d.; April 7, £117 5s. to £117 7s. 6d.; April 8, £113 17s. 6d. to £114.

Three Months.—April 1, £121 5s. to £121 7s. 6d.; April 2, £120 12s. 6d. to £120 15s.; April 7, £118 12s. 6d. to £118 15s.; April 8, £115 7s. 6d. to £115 10s.

Spelter.—The outlook for spelter does not seem favourable, in spite of the low price. Under present industrial conditions the consuming trades have no incentive to buy. The trade demand is thus insufficient to warrant a sustained advance, and the market has an uncertain tendency.

Daily fluctuations :—

Ordinary.—April 1, £11 15s.; April 2, £12; April 7, £11 16s. 3d.; April 8, £11 13s. 9d.

Lead.—Consumers are taking very little interest in this market. There is a general lack of confidence in the industrial prospects, and it certainly cannot be said that the outlook at the moment is promising.

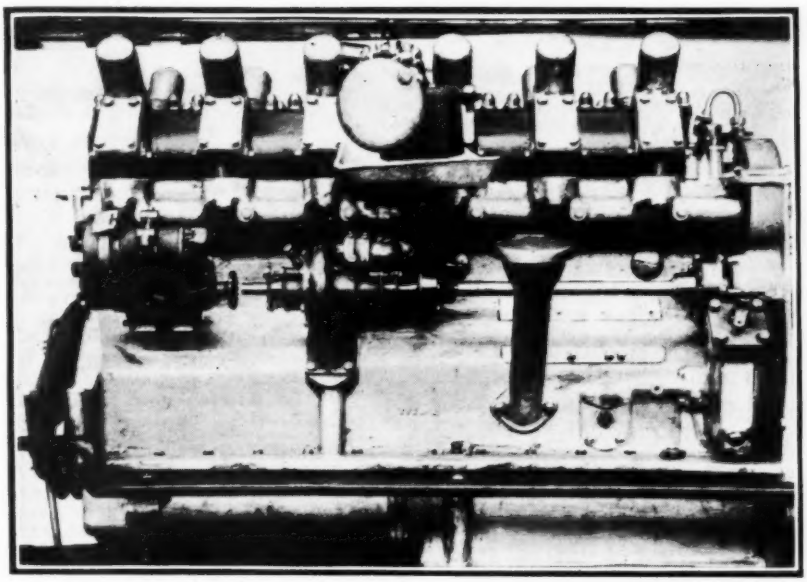
The week's prices have been :—

Soft Foreign (prompt).—April 1, £12 2s. 6d.; April 2, £12 15s.; April 7, £12 8s. 9d.; April 8, £12 5s.

Structural Steel in Building.—A three-storey building structure in steel has been erected at Watford by contractors for the Department of Scientific and Industrial Research, working in conjunction with the British Steelwork Association. Observations are to be made on this structure under various conditions of loading. The maximum load which it is intended to apply is 27 tons, which is supplied by means of a series of tanks to be filled with water. Each tank, when full, will weigh 1 ton.

A 20,000-kw. Mercury-Vapour Turbine.—A 20,000-kw. mercury-vapour turbine generator is to be installed in a new power plant at Schenectady, N.Y. In addition to the 20,000-kw. mercury boiler and turbine, the new outdoor station will include a steam boiler to supply 300,000 lbs. of steam per hr., as well as a by-product output of 330,000 lbs. per hr. from the mercury condenser. Adjacent to the power station site is the sub-station through which the electric energy from the mercury turbine is supplied to the 110,000-volt transmission system. Mercury required in the boiler will weigh approximately 250,000 lbs. The principle of operation is as follows: Mercury is boiled and vaporised at a pressure of 125 lbs. gauge and a temperature of 958 deg. Fah. The mercury vapour drives a mercury turbine and at the exhaust end of the turbine the mercury vapour still contains sufficient heat to vaporise water and make steam at pressures in common use. A large part of the power generated from the mercury turbine is obtained at high efficiency since practically all the heat in the exhaust is utilised.—"Steel."

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."



Maudslay 6-Cylinder 120-B.H.P. engine ; aluminium castings include crankcase, oil sump, cylinder water jacket and pistons.

F.T.J. 9.4.31

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Lower running costs, more speed and more space are the urgent needs of transport to-day. Chassis must be lightened for this reason and therefore light alloys of aluminium are chosen for such parts as crankcases, oil sumps, gearboxes, cylinders and water jackets.

Combining high thermal conductivity with lightness and strength, aluminium alloys figure also in cylinder heads, pistons, brake shoes and brake drums.

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Special CARBON BLACKING

67 YEARS EXPERIENCE. MADE BY A FIRM WITH

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Also—

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STUDS, CHAPLETS, BRUSHES, CORE ROPES, BUCKETS, SPADES, Etc. LADLES, FIRE BRICKS, STONE FLUX, CASTING CLEANERS, PIPE NAILS, SPRIGS, WIRE BRUSHES, BELLOWS.

JAS. DURRANS & SONS LIMITED.

PHŒNIX WORKS, PENISTONE, NR. SHEFFIELD.

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	42 11 3
Three months	43 5 0
Electrolytic	45 10 0
Tough	43 15 0
Best selected	44 5 0
Sheets	77 0 0
India	56 0 0
Wire bars	47 12 6
Do., May	47 12 6
Do., June	47 12 6
Ingot bars	47 12 6
H.C. wire rods	48 10 0
Off. av. cash, March	44 17 2¼
Do., 3 mths., March	45 7 6 1/2
Do., Sttlmnt., March	44 17 4 7/11
Do., Electro, March	48 3 4 1/11
Do., B.S., March	46 9 8⅜
Do., wire bars, March	48 12 10 1/11
Solid drawn tubes	11d.
Brazed tubes	11d.
Wire	7d.

BRASS.

Solid drawn tubes	9¾d.
Brazed tubes	11¾d.
Rods, drawn	9¼d.
Rods, extd. or rlld.	5¼d.
Sheets to 10 w.g.	8¼d.
Wire	8¼d.
Rolled metal	7¾d.
Yellow metal rods	5¼d.
Do. 4 × 4 Squares	6d.
Do. 4 × 3 Sheets	6¼d.

TIN.

	£ s. d.
Standard cash	113 17 6
Three months	115 17 6
English	115 0 0
Bars	118 0 0
Straits	117 10 0
Australian	116 10 0
Eastern	119 10 0
Banca	118 0 0
Off. av. cash, March	121 18 4 1/11
Do., 3 mths., March	123 8 4 2/11
Do., Sttlmt., March	121 18 2 7/11

SPELTER.

	£ s. d.
Ordinary	11 13 9
Remelted	10 15 0
Hard	9 7 6
Electro 99.9	14 2 6
English	12 5 0
India	11 0 0
Zinc dust	19 10 0
Zinc ashes	2 15 0
Off. aver., March	12 8 7 13/44
Aver. spot, March	12 3 9 1/2 2

LEAD.

	£ s. d.
Soft foreign ppt.	12 5 0
English	13 15 0
Off. average, March	13 4 9 1/2
Average spot, March	13 2 6 15/22

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	21 0 0
Do., V.M. ex-whf.	20 0 0
Rods	23 0 0
Boiler plates	14 0 0
Battery plates	15 15 0

ANTIMONY.

	£ s. d.
Special brand, Eng.	36 0 0
Chinese	25 0 0
Crude	22 0 0

QUICKSILVER.

	£ s. d.
Quicksilver	22 7 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	7 10 0
45/50%	10 10 0
75%	17 0 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£15 15 0
Ferro-tungsten—	
80/85%	2/– lb.
Tungsten metal powder—	
98/99%	2/3 lb.
Ferro-chrome—	
2/4% car.	£29 0 0
4/6% car.	£21 0 0
6/8% car.	£19 17 6
8/10% car.	£19 12 6
Ferro-chrome—	
Max. 2% car.	£30 10 0
Max. 1% car.	£34 0 0
Max. 0·70% car.	£36 5 0
70% carbon-free	10d. lb.
Nickel—99% £170 0 0 to £175 0 0	
Ferro-cobalt	9/3 lb.
Aluminium 98/99%	£85 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£11 0 0
76/80% packed	£12 0 0
76/80% export	£ 9 0 0
Metallic manganese—	
94/96% carbonless	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/– lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/– lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

South Wales	£ s. d.	£ s. d.
Heavy steel		2 7 6
Bundled steel and shrngs.	1 18 0	to 2 3 0
Mixed iron and steel	1 18 0	to 2 1 0
Heavy cast iron	2 8 0	to 2 10 0
Good machinery for foundries		2 12 6

Cleveland—	
Heavy steel	2 5 0
Steel turnings	1 10 0
Cast-iron borings	1 5 0
Heavy forge	2 15 0
W.I. piling scrap	2 11 6
Cast-iron scrap	2 7 6 to 2 9 0

Midlands—	
Light cast-iron scrap	1 17 6
Heavy wrought	2 17 0
Steel turnings	—

Scotland—	
Heavy steel	2 5 0
Ordinary cast iron	2 7 6
Engineers' turnings	1 12 6
Cast-iron borings	1 13 6
Wrought-iron piling	2 12 6
Heavy machinery	2 11 6

London—Merchants' buying prices delivered yard.

Copper (clean)	37 0 0
Brass	26 0 0
Lead (less usual draft)	10 0 0
Tea lead	7 0 0
Zinc	6 0 0
New aluminium cuttings	50 0 0
Braziery copper	34 0 0
Gunmetal	35 0 0
Hollow pewter	76 0 0
Shaped black pewter	56 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/–
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/–
Hematite No. 1	67/6
Hematite M/Nos.	67/–
N.W. Coast—	
Hem. M/Nos. d/d Glas.	75/–
„ d/d Birm.	86/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
„ No. 4 forge*	66/–
„ No. 3 fdry.*	71/–
Shrops basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	62/6
„ fdry. No. 3*	67/6
„ fdry. No. 1*	70/6
Derbyshire forge*	66/–
„ fdry. No. 3*	71/–
„ fdry. No. 1*	74/–
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	76/–
„ No. 3	73/6
Hem. M/Nos. d/d	72/–
Sheffield (d/d district)—	
Derby forge	61/–
„ fdry. No. 3	66/–
Lincs forge	—
„ fdry. No. 3	66/–
E.C. hematite	81/6
W.C. hematite	84/6
Lancashire (d/d eq. Man.)—	
Derby forge	64/6
„ fdry. No. 3	69/6
Staffs fdry. No. 3	69/6
Northants fdry. No. 3	68/–
Cleveland fdry. No. 3	69/6
Dalzell, No. 3 (special)	105/– to 107/6
Summerlee, No. 3	89/– to 90/–
Glengarnock, No. 3	—
Eglinton, No. 3	89/– to 90/–
Gartsherrie, No. 3	89/– to 90/–
Monkland, No. 3	89/– to 90/–
Shotts, No. 3	89/– to 90/–

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	10 0 0 to	10 10 0
Nut and bolt iron	8 12 6 to	8 15 0
Hoops	10 10 0 to	12 0 0
Marked bars (Staffs) f.o.t.		12 10 0
Gas strip	10 10 0 to	12 0 0
Bolts and nuts, ¾ in. × 4 in.		14 5 0

Steel—	£ s. d.	£ s. d.
Plates, ship, etc.	8 15 0 to	8 17 6
Boiler plts.	9 5 0 to	10 5 0
Chequer plts.		10 7 6
Angles		8 7 6
Tees		9 7 6
Joists		8 15 0
Rounds and squares, 3 in. to 5½ in.		9 7 6
Rounds under 3 in. to ⅜ in. (Untested)	7 2 6 to	7 15 0
Flats—8 in. wide and over		8 12 6
„ under 8 in. and over 5 in.		8 17 6
Rails, heavy	8 5 0 to	8 10 0
Fishplates		12 0 0
Hoops (Staffs)	9 5 0 to	9 10 0
Black sheets, 24g.	8 10 0 to	9 10 0
Galv. cor. shts. 24g.		11 0 0
Galv. flat sheets		11 10 0
Galv. fencing wire, 8g. plain		12 0 0
Billets, soft	5 5 0 to	5 12 6
Billets, hard	7 2 6 & up.	
Sheet bars	5 0 0 to	5 12 6
Tin bars	5 0 0 to	5 12 6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	11½d.
Sheet to 10 w.g.	1/–
Wire	1/1
Rods	1/–
Tubes	1/7
Castings	1/–

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1¼ to 1/7¼
To 15 in. wide	1/1¼ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
3/– to 10 g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	17.76
No. 2 foundry, Valley	16.50
No. 2 foundry, Birm.	12.00
Basic	18.26
Bessemer	18.76
Malleable	18.76
Grey forge	17.76
Ferro-mang. 80%	80.00
O.-h. rails, h'y, at mill	43.00
Billets	30.00
Sheet bars	30.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.65
Tank plates	1.65
Beams, etc.	1.65
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.90
Sheets, black, No. 24	2.35
Sheets, galv., No. 24	2.90
Sheets, blue an'l'd, No. 13	2.05
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	22/6 to 25/–
„ furnace	15/– to 17/–
Durham and Northumberland—	
„ foundry	13/6
„ furnace	13/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	15/3
„	28×20 „	30/6
„	20×10 „	22/3
„	18¾×14 „	16/1½
C.W.	20×14 „	14/3
„	28×20 „	28/6
„	20×10 „	21/–
„	18¾×14 „	15/–
Terneplates	28×20	31/– per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 10 0
Bars, hammered, basis	£17 10 0 to £18 10 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 15 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£20 0 0 to £24 0 0
Bars and rods dead soft, st'l	£11 0 0 to £14 0 0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ½ in. up to 6 in.

	Tubes.	Fittings.
Gas	62½%	47½%
Water ..	58½%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Apr.	1 ..	43	7	6	inc.	8/9
,,	2 ..	43	2	6	dec.	5/-
,,	7 ..	42	16	3	,,	6/3
,,	8 ..	42	11	3	,,	5/-

Electrolytic Copper.

		£	s.	d.		
Apr.	1 ..	45	10	0	No change	
,,	2 ..	45	10	0	,, ,,	
,,	7 ..	45	10	0	,, ,,	
,,	8 ..	45	10	0	,, ,,	

Standard Tin (cash).

		£	s.	d.		
Apr.	1 ..	119	15	0	inc.	10/-
,,	2 ..	119	5	0	dec.	10/-
,,	7 ..	117	5	0	,,	40/-
,,	8 ..	113	17	6	,,	67/6

Tin (English ingots).

		£	s.	d.		
Apr.	1 ..	120	15	0	inc.	10/-
,,	2 ..	120	5	0	dec.	10/-
,,	7 ..	118	5	0	,,	40/-
,,	8 ..	115	0	0	,,	65/-

Zinc Sheets (English).

		£	s.	d.		
Apr.	1 ..	21	0	0	No	change
,,	2 ..	21	0	0	,,	,,
,,	7 ..	21	0	0	,,	,,
,,	8 ..	21	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Apr.	1 ..	11	15	0	inc.	2/6
,,	2 ..	12	0	0	,,	5/-
,,	7 ..	11	16	3	dec.	3/9
,,	8 ..	11	13	9	,,	2/6

Lead (English).

		£	s.	d.		
Apr.	1 ..	13	10	0	No	change
,,	2 ..	14	0	0	inc.	10/-
,,	7 ..	13	15	0	dec.	5/-
,,	8 ..	13	15	0	No	change

AVERAGE MONTHLY PRICES OF STEEL SHIP PLATES (NORTH OF ENGLAND).

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	5 0 0	5 0 0	5 2 6	5 2 6	5 2 6	5 0 0	5 0 0	5 0 0	5 0 0	5 2 6	5 10 0	5 10 0	5 2 6
1897	5 10 0	5 10 0	5 10 0	5 7 6	5 2 6	5 2 6	5 0 0	5 0 0	5 0 0	5 0 0	5 7 6	5 10 0	5 5 5
1898	5 10 0	5 8 9	5 8 9	5 10 0	5 16 3	5 18 9	5 17 6	6 0 0	6 2 6	6 5 0	6 10 0	6 15 0	5 18 6½
1899	6 15 0	7 0 0	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 12 6	7 12 6	7 12 6	7 12 6	8 0 0	7 6 5½
1900	8 0 0	8 0 0	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 0 0	8 0 0	8 0 0	7 10 0	7 0 0	8 0 0
1901	6 15 0	6 15 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 7 6	6 5 0	6 0 0	6 0 0	6 4 4
1902	5 17 6	5 12 6	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 10 0	5 10 0	5 14 7½
1903	5 10 0	5 10 0	5 15 0	6 0 0	6 0 0	6 0 0	5 12 0	5 12 6	5 12 6	5 12 6	5 12 6	5 10 0	5 13 11
1904	5 7 6	5 10 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 11 10
1905	5 15 0	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	6 0 0	6 10 0	7 0 0	7 0 0	6 2 3½
1906	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 10 0	7 0 10½
1907	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 8 4
1908	6 10 0	6 10 0	6 10 0	6 5 0	6 5 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 3 9
1909	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	5 15 0	5 15 0	5 15 0	6 0 0	6 0 0	6 0 0	6 0 0	5 18 9
1910	6 5 0	6 5 0	6 7 6	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 2
1911	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 18 4	6 15 3½
1912	7 3 9	7 5 0	7 5 0	7 12 6	7 15 0	7 15 0	7 15 0	8 0 0	8 0 0	8 0 0	8 2 0	8 5 0	7 14 10
1913	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	7 19 0	7 15 0	7 3 0	6 15 0	6 10 0	7 16 5½
1914	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 0 0	6 0 0	7 0 0	7 5 0	7 5 0	7 6 3	7 10 0	6 14 8½
1915	8 0 0	8 10 0	9 0 0	9 10 0	9 10 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 5 0	11 0 0	9 12 11
1916	11 7 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 9 2
1917	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1918	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1919	11 10 0	14 0 0	14 0 0	14 0 0	17 0 0	17 7 6	17 15 0	18 5 0	18 5 0	18 5 0	19 12 6	21 5 0	16 15 5
1920	22 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	24 0 0	24 10 0	24 5 0	24 5 0	23 13 4
1921	23 5 0	22 10 0	20 4 0	19 0 0	19 0 0	17 0 0	15 0 0	14 15 0	13 12 0	12 5 0	10 10 0	10 10 0	16 9 3
1922	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 4 0	10 0 0	9 7 6	9 4 0	9 5 0	9 5 0	9 5 0	9 18 4½
1923	9 7 6	9 15 0	10 5 0	10 10 0	10 10 0	10 10 0	9 18 9	9 17 6	9 17 6	9 17 6	9 18 6	10 6 10½	10 1 2½
1924	10 1 6	9 18 1½	9 17 6	9 17 6	9 17 6	9 19 4½	10 5 0	10 5 0	10 5 0	9 19 0	9 15 0	9 15 0	9 19 7½
1925	9 14 0	9 10 0	9 10 0	9 1 3	9 0 0	9 0 0	8 17 0	8 13 1½	8 7 6	8 5 6	7 16 3	7 14 3	8 15 8½
1926	7 12 2½	7 12 6	7 12 6	7 14 4½	7 15 0	7 16 10½	8 2 6	8 2 6	8 4 0	8 12 6	8 16 3	8 1 1½	
1927	8 17 6	8 17 6	8 11 6	8 7 6	8 6 3	8 5 0	8 5 0	8 3 9	8 2 6	8 2 6	8 5 0	8 5 0	8 7 5
1928	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 6 10½
1929	8 7 6	8 7 6	8 7 6	8 7 6	8 10 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 13 9	8 10 9½
1930	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1931	8 15 0	8 15 0	8 15 0	—	—	—	—	—	—	—	—	—	—

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOUNDRY Foreman, age 45, requires position; practical knowledge of dry- and green-sand castings, iron and brass; free April 30.—Box 774, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Manager wanted for Motor and General Trade. Well up in latest practice and good knowledge of Plate and Machine Moulding.—Apply, stating age, experience, and salary required, to Box 772, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of The Foundry Trade Journal.

Any Member, Associate Member or Associate of the Institute of British Foundrymen who desires his qualifications to be inserted in the column must forward to the General Secretary of the Institute the following information:—(a) Name and address; (b) name of present employer (or last employer if unemployed); (c) brief particulars of qualifications, experience, and type of position required. The name will not be disclosed until the candidate is in communication with a prospective employer. Announcements will be inserted in two successive issues, unless announcers' requirements have been met with in the meantime.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

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Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester.

YOUNG, energetic Assistant Foundry Manager desires change. Capable of taking entire charge of foundry; also wood and metal pattern shops. Has good theoretical knowledge and sound practical training. Used to mass production of Automobile Castings in Grey Cast Iron and Aluminium on up-to-date lines. Special study of sand control and cupola practice. (101)

METALLURGICAL Engineer; furnace and heat-treatment expert with extensive works, laboratory and sales experience, requires position. Experience includes complete control of laboratories, iron and non-ferrous foundries, forge and heat-treatment department. Electric furnace practice and manufacture of stainless iron and steel. (102)

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145,000 Sq. Ft. of SHOPPING,

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Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

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ALBION WORKS, SHEFFIELD.

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SAND MIXERS.—New and Secondhand. Ask us to quote.—W. Brealey & Company, Limited, Station Works, Ecclesfield, Sheffield.

UNIVERSAL Mixers for Sand Colours, Chemicals, Blacklead, etc., different sizes. Also Super Abrasive Grinders and Steel Attrition Grinder and Dresser. Grind to any degree of fineness.—Booth & Son, Grinding, Crushing and Mixing Engineers, Congleton, Cheshire.

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250 cub. ft. ALLEY & MACLELLAN Vertical Belt-driven Air Compressor; against 70 lbs. pressure at 250 r.p.m.

250 cub. ft. WILSON Horizontal Belt-driven Air Compressor; against 80 lbs. pressure at 140 r.p.m.

EVANS 7½-in. x 6-in. Three-throw Vertical Ram Pump, driven by 220-volt Motor.

300-b.h.p. Semi-Diesel Crude Oil Engine, by VICKERS PETTERS.

"Raymond" ROLLER MILL, to reduce about 6 tons of bituminous coal per hr. so that 90 per cent. will pass 100 mesh.

15-ton STEAM DERRICK CRANE (Anderson), 65-ft. steel jib, 33-ft. steel mast; 80 lbs. w.p.

New COCHRAN BOILER, 12 ft. 3 in. high x 5 ft. 6 in. dia.. working steam pressure 100 lbs. per sq. in.

One 20-n.h.p. PORTABLE STEAM ENGINE AND BOILER.

FOUNDRY LADLES, various types and sizes.

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ALBION WORKS, SHEFFIELD.

PUBLICATION.

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1930 edition. Price 42s., bound in cloth.—Industrial Newspapers, Ltd., 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS.

GANISTER, best quality for cupolas, also for Steel Works.—Astbury Silica Company, "The Brooms," Park Lane, Congleton.

MISCELLANEOUS—*Continued.*

PATTERNMAKING.—Quotations by return post for patterns of all descriptions. Keen prices and reliable, good work. Your inquiries will receive personal attention. Prompt deliveries. — H. Leggett, Westbury Street, Worcester. 'Phone 1059.

ADDRESSOGRAPH Machine (Pedal), in good working order, with cabinet attached, including some drawers, for disposal.—Address replies to Box 1768, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

'Phone: 287 SLOUGH

MOULDING MACHINES

1 "Coventry" headram squeezer, new		£22
2 Britannia No. 1 jolters new	each	£36
3 Britannia No. 2 jolters, new	each	£38
1 Britannia 20″×16″ jolt squeezer, new		£45
1 "Shockless" 72″×60″ plain jolter		£90
4 Adaptable machines, standard type	each	£14
1 Darling & Sellars 24″×18″ turnover		£14
1 Farwell type plain squeezer		£8

PLEASE NOTE PRICES!

BUY FROM ME AND SAVE MONEY!

Alex. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

SCHOOL FOR THE BLIND
(Founded 1838)
SWISS COTTAGE, LONDON, N.W. 3

HEAD OFFICES: 65, 65a, SOUTHWARK ST., LONDON, S.E.1.
Phone: Hop 1305.

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CAST IRON
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Castings for all purposes.

Phone: Stockton-on-Tees, 741.
CHAS. P. KINNELL & CO., LTD., Vulcan Ironworks, Thornaby-on-Tees.